

CPU

COMPUTER POWER USER



THE RIDDLER
JACKY HIGLEY DROPS THE MIC

NCIX PC SOC CHAMPION SERIES



THE OFFICIAL GIGABYTE ESPORTS
GAMING MACHINE P. 12



ASUS Z170 MOTHERBOARDS

UNLEASH THE 6TH GEN CORE.
CHOOSE THE **BEST**.

STAY IN FRONT.

A detailed view of the ASUS Maximus VIII Hero motherboard, showing its intricate circuitry, various ports, and the distinctive ROG (Republic of Gamers) branding. The motherboard is dark in color with silver and red accents. A red circle highlights the 'MAXIMUS VIII HERO' text on the board. The background features a blue and black gradient with vertical lines on the left.

MAXIMUS VIII HERO

ACCEPT ALL CHALLENGES.

- 1-click OC for maximum performance and stability
- Onboard audio reinvented with ROG SupremeFX 2015
- No lag gaming with Intel® I219-V Ethernet

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Z170-DELUXE

HIT YOUR TARGET.

- 5-Way Optimization ensures BEST performance
- Go faster with onboard 3x3 802.11ac Wi-Fi
- Dual M.2 PCIe 3.0 x4 for incredible storage speed



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Our latest build, which will be raffled off at QuakeCon in Dallas later this month!

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Monthly last-page interview with people who help to shape the PC industry.

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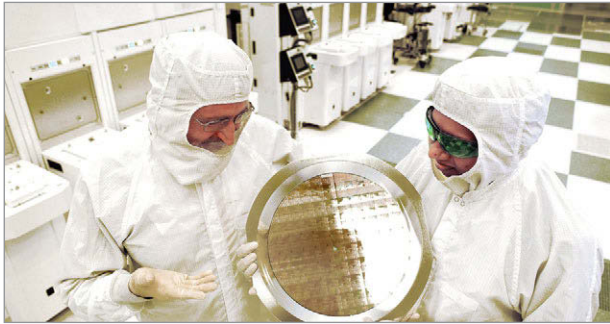


Photo: IBM

IBM Research Alliance Announces Chip Manufacturing Breakthrough

The manufacturing technologies necessary to build ever-smaller transistors appear to be nearing their physical limits, but the viability of Moore's Law may have just gotten another extension, as a team led by IBM Research has announced it has made chips with working transistors using a 7nm (nanometer) manufacturing process. The 7nm technology should enable semiconductor companies to produce fingernail-sized chips containing 20 billion or more transistors. By comparison, Intel's latest Broadwell processors are made using a 14nm process and contain around 2 billion transistors. Scientists from GLOBALFOUNDRIES, Samsung, and the SUNY Polytechnic Institute participated with researchers from IBM in producing the 7nm test chips. You can read more about the new technology and their breakthrough announcement at ibm.co/1TqFKIT.

Swiftech's KOMODO-NV Cooler Can Handle Titan X & GTX 980 Ti

Komodo-NV liquid coolers from Swiftech offer water blocks machined out of high-quality acrylic that completely cover graphics cards from NVIDIA. The Komodo-NV Titan X ECO works with both TITAN X and GTX 980 Ti reference boards. The full-cover waterblock ensures all critical components of the card are in the coolant's flow path and also protects the card from accidental bending. The acrylic block has a chrome-plated copper base (a trademark of Swiftech), which the company says provides superior durability over the nickel plating you'll find on most competing coolers. An optional backplate made of brushed black anodized aluminum is available; the plate offers additional cooling for memory found on the back side of TITAN X cards but is still fully compatible with the latest GTX 980 Ti cards. MSRP is \$115.95 for the block; the backplate is another \$29.95.



WATCHING THE CHIPS FALL

Here is the pricing information for various AMD and Intel CPUs.

CPU	Released	Original Price	Last Month's Price	Online Retail Price*
AMD FX-9590 Eight-Core	6/11/2013	N/A	\$229.99	\$229.99
AMD FX-9370 Eight-Core	6/11/2013	\$375	\$209.99	\$229.99
AMD FX-8350 Eight-Core	10/23/2012	\$195	\$169.99	\$174.99
AMD FX-8320 Eight-Core	10/23/2012	\$169	\$139.99	\$144.99
AMD FX-6350 Six-Core	4/30/2013	\$132	\$125.99	\$125.99
AMD A10-7850K Quad-Core	1/14/2014	\$173	\$129.99	\$129.99
AMD A10-7800 Quad-Core	7/2/2014	\$153	\$124.99	\$124.99
AMD A10-7700K Quad-Core	1/14/2014	\$152	\$129.99	\$119.99
AMD A10-6800K Quad-Core	6/4/2013	\$142**	\$133.95	\$139.99
AMD A10-5800K Quad-Core	10/2/2012	\$122**	\$89.99	\$89.99
Intel Core i7- 5960X Eight-Core	8/29/2014	\$999**	\$1,049.99	\$1,049.99
Intel Core i7- 4960X Six-Core	9/3/2013	\$990**	\$1,029.99	\$1,029.99
Intel Core i7- 5930K Six-Core	8/29/2014	\$583**	\$579.99	\$579.99
Intel Core i7- 4930K Six-Core	9/3/2013	\$583**	\$614.98	\$618.16
Intel Core i7- 5820K Six-Core	8/29/2014	\$389**	\$389.99	\$389.99
Intel Core i7-4790K Quad-Core	6/25/2014	\$339**	\$339.99	\$339.99
Intel Core i7-4770K Quad-Core	6/2/2013	\$339**	\$396.99	\$426.99
Intel Core i7-4820K Quad-Core	9/3/2013	\$323**	\$322.29	\$327.99
Intel Core i7-4790 Quad-Core	5/11/2014	\$303**	\$309.99	\$309.99
Intel Core i5-4690K Quad-Core	6/3/2014	\$242**	\$239.99	\$239.99

* As of July 2015

** Manufacturer's estimated price per 1,000

ADATA Launches XPG 930 Series SSDs For Gamers & Overclockers

ADATA is launching a new series of SSDs that targets gamers and overclockers. The XPG 930 Series uses enterprise-grade multi-level cell NAND memory and incorporates a DDR3 DRAM Cache Buffer that ADATA says provides up to twice the random read/write speed as drives without the buffer. The 2.5-inch SATA 6Gbps SSDs use JMicron controllers and reach sequential read/write speeds of up to 560/460MBps. They support a number of safety and reliability features and come with a five-year warranty. The drives should be available at retail soon in 120GB, 240GB, and 480GB sizes.



ASUS Adds R9 Fury To Strix Gaming Graphics Cards Lineup

ASUS is adding a new member to its Strix line of graphics cards. The Strix R9 Fury is based on AMD's Fiji graphics processor and includes 4GB of HBM (High Bandwidth Memory). The card features the new Direct CU III air cooler with specially designed fan blades that ASUS says improve airflow and static pressure 105% over other fans. ASUS says its Direct CU III cooler helps the Strix R9 Fury run 30% cooler and up to 3X quieter than reference cards. Other features of the Strix R9 Fury include a new Strix LED with pulsating light effects. Retail for the card runs around \$570.



Samsung Announces Two 2TB SSD Models: 850 EVO & 850 PRO

Samsung recently announced two new large-capacity SSDs. The 850 PRO and 850 EVO both have a maximum capacity of 2TB. The drives have the same 2.5-inch aluminum casing (the PRO features a red square on top) and they both use 128Gb 3D V-NAND chips and a high-performance MHX controller. The main difference between the two is the warranty: Samsung guarantees the 850 PRO for 10 years or 300 terabytes written, while it backs the 850 EVO for five years or 150 terabytes written. Expect prices of \$1,000 for the PRO and \$800 for the EVO.



EK Releases Single-Slot, Full-Cover Waterblock For R9 FURY X Cards

EK has released the EK-FC R9 FURY X waterblock for graphics cards based on AMD's new Radeon Fury X GPU. The EK cooler is a full-cover waterblock with your choice of a bare or nickel-plated electrolytic copper base that pairs with either an acrylic or POM Acetal top. EK says the unique split-flow design of the block offers superior cooling even in systems with weaker water pumps. The single-slot cooler also has FC Terminal connection ports so you can swap out cards in a multi-card system without changing the cooling loop. Pricing runs \$113.99 to \$125.49, depending on material.



Cougar Launches New Flagship Gaming Mouse, The 550M

Cougar's new 550M gaming mouse is all about customization. It has six buttons, including a trigger button located behind the scroll wheel, that can be customized for up to 21 functions. The optical sensor, which offers up to 6,400dpi of sensitivity, can also be adjusted by the user, as can the 1,000Hz polling rate. Preferences can be saved in three configurations thanks to 512Kb of onboard memory. All settings and adjustments can be implemented quickly using Cougar's UIX gaming device management software. The 550M will be available this month with an MSRP of \$59.



BitFenix Adds New Features To Alchemy 2.0 LED Lighting Strips

BitFenix has updated its Alchemy lighting line to make the LED strips even better. The new Alchemy 2.0 LED strips are embedded with magnets and can be attached to any steel part of a case or component. They attach easily and can be moved and re-used as you wish. BitFenix has added purple to its existing color selection and tweaked the wavelength of the green LEDs so they now match the neon green used on NVIDIA graphics cards. Alchemy 2.0 Magnetic LED Strips are available in three lengths: 12cm (6 LEDs), 30cm (15 LEDs), and 60cm (30 LEDs), and they come in white, red, green, blue, and purple. Pricing varies.



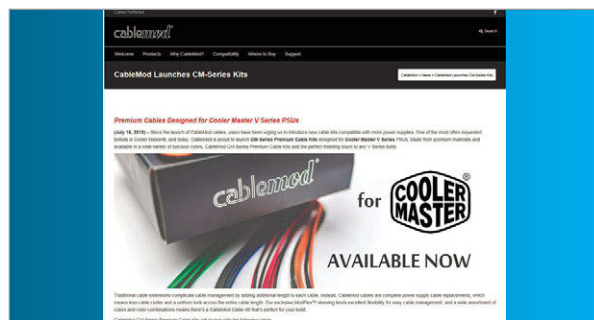
EVGA Releases KINGPIN Edition GTX 980 Ti; Pre-Binned For OC'ers

EVGA's fastest GeForce GTX 980 Ti card, the K[NGP]N edition, is a special treat for overclockers. Created with the assistance of the world-famous overclocker it's named after, the K[NGP]N card has a special twist: EVGA has pre-binned the ASIC quality of the card at four levels and price points: 72%+ (\$849.99); 74%+ (\$899.99); 76%+ (\$999.99); and 80%+ (\$1,049.99). Users can select the level that best fits their budget. Additional OC goodies include a 14+3 power phase and full digital VRM, quick-switch triple BIOSes, onboard thermal sensors, real-time voltmeter, and more.



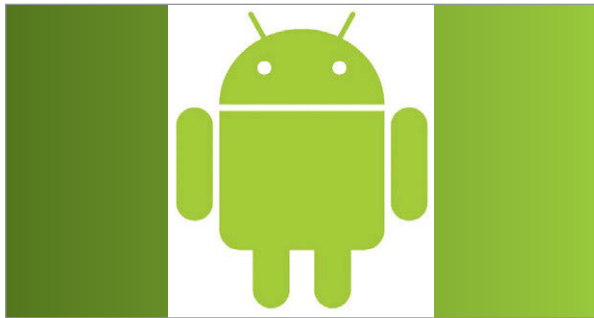
CableMod Announces Cable Kits For Cooler Master V Series PSUs

CableMod has announced it has created new cabling kits that will work with the V series of PSUs from Cooler Master. The cables come in a range of solid colors and color combinations. Just pick the color or color combination that works best with your system, order the kit, and then when it arrives, replace the cables on your V series PSU with the ones in the kit. It's a big timesaver over resleeving individual cables. Plus, if you end up using the PSU in another system, you can always change out the cables again. To find vendors who carry the kits, visit www.cablemod.com.



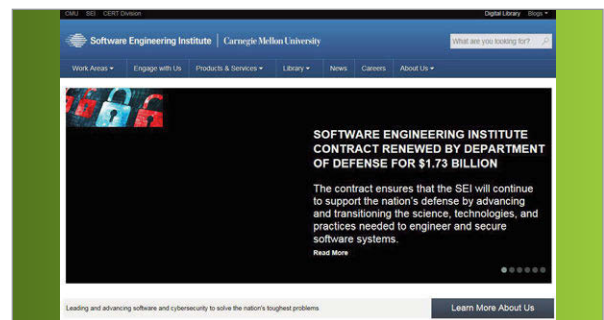
Stagefright Vulnerability Poses Threat To 950 Million Android Users

Experts at mobile security company Zimperium recently uncovered a vulnerability in an Android media library called Stagefright that may be present in as many as 950 million Android phones. The Stagefright vulnerability could allow crackers to remotely execute code on the devices simply by texting a media file to the phone; all the bad guys need is your phone number. Due to the seriousness and scope of the potential threat, Zimperium notified Google's Android Security team and also submitted patches that could fix the problem. Go to <http://blog.zimperium.com> for more info.



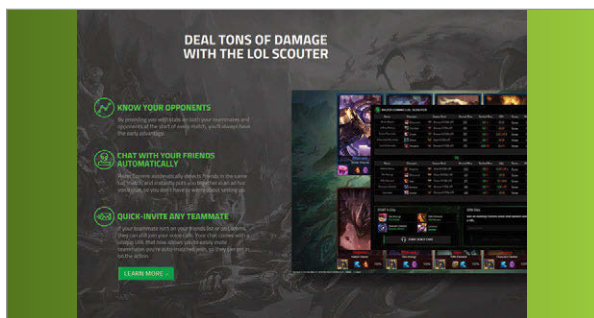
DoD Renews Funding For CMU's Software Engineering Institute

Carnegie Mellon University's Software Engineering Institute was founded in 1984 and is currently the only federally funded R&D center focusing on software-related security and engineering topics. The Department of Defense recently notified the SEI it was renewing its contract with the center for five more years, with an option for another five years, for a total commitment of up to \$1.73 billion. With ongoing concerns about cybersecurity and the growing importance of software in the U.S. economy, don't be surprised if the DoD opts to exercise that "another five years" clause.



Razer's New LoL Scouter Program Provides Voice Chat & Player Info

League Of Legends players have a new tool in their arsenals: Razer's LoL Scouter VoIP software. LoL Scouter is an add-in for the Razer Comms free suite of communications software. LoL Scouter lets players communicate using voice chat and includes a feature that lets users invite teammates to join calls by pasting a URL link in the LoL Scouter window. Along with the communications tools, LoL Scouter displays critical information about other players, such as their experience level, season rank, Kill/Death/Assist totals, Runes, and Masteries. Download at www.razerzone.com/comms/.



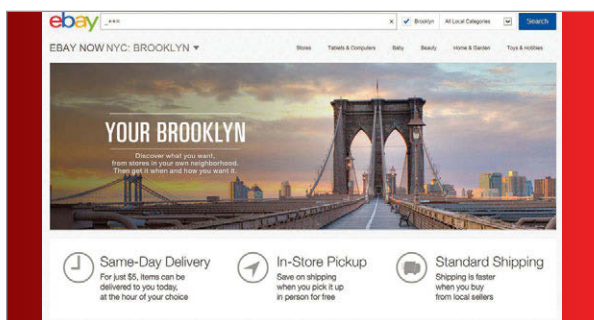
Wondering What's Growing In Your Yard? GardenAnswers Will Tell You.

GardenAnswers is a new app for iOS and Android that you can use to identify plants. Just take a photo of any plant, and the app will offer up images of possible matches; you then select the one that looks most like the plant in question. GardenAnswers not only identifies the plant, but it also provides horticultural information such as suggestions for care and maintenance. If the app can't identify your plant, you can use an option in the app to submit the photo along with questions to outside experts for identification and advice. Download for free at Google Play or the App Store.



eBay Shuts Down eBay Now Pilot

Need that latest eBay purchase today? You're out of luck as eBay is ending the eBay Now service in the United States (service in the UK will still continue). In announcing the end of the service, eBay noted it saw encouraging results from eBay Now but had always intended it as a pilot. Now, eBay will focus efforts on exploring delivery and pick-up/drop-off programs that are relevant to more of its 25 million sellers and cover a larger variety of products. In other eBay-lover news, you'll soon notice the disappearance of several apps you may have downloaded, including eBay Valet, Fashion, and Motors. Those special-purpose apps and others will be integrated into the core eBay apps.



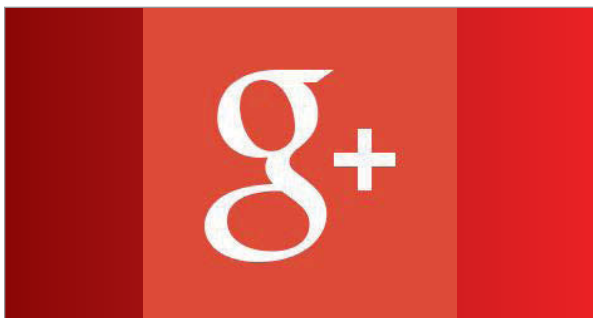
Amazon Competitor Jet Launches

Shopping club Jet.com is now open to the public, promising new technology that makes online shopping smarter and more efficient. For \$49.99 a year, members can save on virtually everything they buy online; Jet guarantees that members will save at least the cost of membership, or it will refund the difference. Jet Founder and CEO Marc Lore says the site is engineered more like a financial trading system than a traditional e-commerce marketplace, with all cost savings passed back to customers (Lore says Jet's model is to only profit on membership fees). Members can shop at the Jet.com website or at hundreds of Jet Anywhere stores on the Web, earning JetCash to spend on future purchases at Jet.com.



Google+ To Be Less "Confusing"

Admitting that users sometimes found Google+ product experiences "confusing," Bradley Horowitz, Google's vice president of streams, photos, and sharing, says in a blog post that the company is going to focus Google+ on "helping users connect around the interests they love, and retire it as the mechanism by which people share and engage within other Google products." Starting soon, you'll only need a Google account, not a Google+ profile, to use certain Google products and services, including YouTube and Google Photos. Good news for those of us who have already created a Google+ profile but don't plan to use the social media service: the company will offer ways to manage and remove the public profiles.



Companies Continue To Ramp Their Investments In The "IoT"

The Internet of Things—the phrase commonly used to describe the growing network of connected devices—is shaping up to be big business. In fact, a new report from Tata Consultancy Services shows that 12% of companies will spend \$100 million on the "latest gadgets-gone-gaga trend" this year and 3% will invest at least \$1 billion. The rewards have been great, with companies reporting an average revenue increase of 15.6% last year as a result of IoT investments. IoT technologies are most commonly used to track customers via mobile apps and track products through production and distribution, the report notes.





Job Of The Month

The company that made “don’t leave home without it” a catchphrase is looking for someone who combines business savvy with technical chops for an important job in their New York offices. American Express, the financial services giant with the credit card empire, is casting its net for a Lead Business Architect in the Global Corporate Payments division. The company says it is building a team that will be responsible for business architecture “across our Global Product Development & Operations.” Applicants should be knowledgeable in multiple disciplines, including business architectures, business analysis, technology strategies, business transformation, and moving teams to Agile development processes. You also need to be familiar with architecture frameworks such as TOGAF and Zachman and be a whiz with application systems design and integration. If you like what you’re reading and want a job with a financial services leader in the Big Apple, see the company’s website for more details.

Source: careers.americanexpress.com

Who Isn’t On The Internet? Nearly 15% Of U.S. Adults

We may live in a world that offers instant communication and nearly limitless access to information, but a sizeable chunk of the adult population in the U.S. isn’t taking part. Approximately 15% of adults (ages 18+) in the country do not use the Internet, according to a survey done by Pew Research. The survey revealed some people thought the Internet was still too difficult to use, some thought it was too expensive, and others just didn’t see any compelling reason to use it. While gender didn’t appear to affect the likelihood of using the Internet, there were some general trends that showed up in the results. For example, the older people are, or the lower their income, the more likely it is they do not go online.

Source: *Pew Research*

Percentages Of U.S. Adults Not Online By Gender, Age & Income

Male	15%
Female	15%
18 - 29	3%
30 - 49	6%
50 - 64	19%
65+	39%
<\$30K	25%
\$30K - \$49,999	14%
\$50K - \$74,999	5%
\$75K+	3%

Seven Years Of College Down The Drain

A study on the state of college hiring by recruiting company Looksharp shows that some degrees are much more likely to lead to work in a related area, at least initially. The research compiled feedback from more than 50,000 college students and recent graduates on their fields of study, internships, and subsequent employment. Good news for left-brained folks who study computer science, math, and engineering: The study showed grads with those degrees are more likely to land jobs in their chosen field.

Percentage Of Graduates Landing Full-Time Work In Their Field Of Study

Computer Science	80.8%	Health Care	47.7%
STEM	71.2%	Law	46%
Graphic Design	64.4%	Communications	42.9%
Nursing	58.7%	Arts	34.8%
Finance	53.1%	Psychology & Counseling	30.6%
Business	49.6%	Political Science	26.6%
Marketing	48.8%	Sociology	18.9%

Source: *Looksharp*

RAW Numbers:

10

Factor by which the market for OLED (organic LED) materials is expected to increase by the year 2022. The OLED market is projected to reach \$970 million by the end of this year, but will jump more than tenfold to \$9.7 billion by 2022.

n-tech Research

40%

Percentage of thermostats sold in 2015 that will be “smart” thermostats. Smart thermostats communicate with other devices and can be controlled remotely using smartphone apps and related technologies.

Parks Associates

91%

Percentage of health-care organizations that experienced at least one data breach during the last two years, according to research by the Ponemon Institute. The institute found that 40% of health-care organizations had five or more breaches during that same period.

Ponemon Institute

\$4.8 billion

Projected size of the commercial market for unmanned aerial systems (UAS), also known as drones, by the year 2021. This compares with a market size of about \$609 million for all of 2014. Companies are starting to use drones to check on remote sites, sell real estate, examine buildings under construction, and make deliveries, among other things.

Radiant Insights

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NCIX PC's SOC Champion Edition

The Official GIGABYTE eSports Gaming Machine



NCIX PC's SOC Champion Edition is GIGABYTE's official eSports gaming machine.

You're likely familiar with NCIX as a retailer of computer parts, as its website (www.ncix.com) and brick-and-mortar stores boast an incredibly diverse selection of enthusiast hardware. But did you know that NCIX has a PC division that produces handcrafted, high-end rigs? NCIX PC's Canadian-based specialists have been designing and building custom computers for 19 years and can create monster rigs with custom liquid cooling loops and high-performance overlocks.

NCIX PC recently announced its SOC Champion Edition systems, which are based on GIGABYTE's GA-X99-SOC Champion

motherboard that's the top choice of many overclockers. "This system exists to showcase the performance that can be extracted from GIGABYTE's top tier components," says Francis Carroll, senior business manager at NCIX PC. "We wanted to offer the gamers a platform that would shatter benchmarks and frame rates, so that they can have the most incredible gaming experience." Interested? We'll dig a little deeper into the SOC Champion Edition rigs.

Mod My Rig

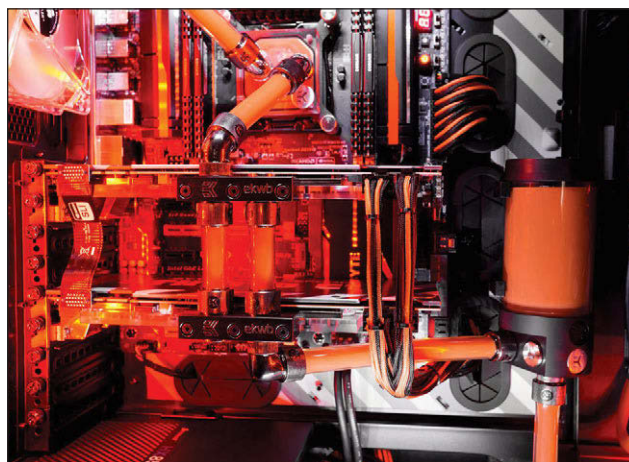
Quality custom-built PCs are more than just a collection of parts, and NCIX PC goes the extra mile to make your rig extra special. "This project serves as an R&D opportunity to bring our watercooling solution to

the next level," says Carroll. "With precise fitting angles and tube lengths, this solution built of traditional tubing offers never-seen-before aesthetics, while being more reliable and easier to maintain than solid tubing."

A complete artisan-crafted mod package is available that includes custom painting, VGA

plates, system lighting, and other internal modifications, such as color-themed cable sleeves. NCIX PC can even create an orange and black theme that mirrors the one found on GIGABYTE's GA-X99-SOC Champion motherboard. There's an overall artistic purpose to the modifications, as well. "We came up with a design that resembles a mix of an oil rig and some sort of mining drone that you might fight in Final Fantasy," says Carroll. "You'll note that the fans, motherboard, and graphics card backplates are showing 'danger lines,' highlighting where most of the action happens in that gaming rig."

Even if you don't go with the complete mod package, you'll be able to customize the internal lighting when configuring your build. NCIX PC uses BitFenix's Alchemy LED Strips (red, blue, green, or white) to illuminate the critical hardware in your



NCIX PC uses EK Water Blocks' liquid cooling components to ensure high-performance and a stylish interior look.

Advertisement

build. On the outside, you can choose either the black and white version of Corsair's Graphite Series 780T. This attractive case features rounded corners and a large window in the side panel that luxuriously shows off the SOC Champion Edition and the rest of your hardware.

NCIX PC's technical specialists take great care to make certain the system you receive is top-notch. "Every system builder at NCIX PC is passionate about his own work," says Carroll. "Once he has the PC assigned to him, he will be the only one working on your PC until he finds that it matches his personal standards of quality." Rigorous testing protocols are part of the NCIX PC process, too, so you can rest assured that you'll receive a PC that'll handle everything you throw at it.

The Champion Selection Phase

System customization is available on most all NCIX PC builds, and on the SOC Champion, you'll have plenty of component options to adjust the gaming system to your ideal performance and budget. To help give you an idea of where to start, NCIX PC offers the SOC Champion Edition in three base system tiers: Tier 1 (\$2,999), Tier 2 (\$3,499), and Tier 3 (\$4,599). NCIX PC also provides technical advisors to assist you. "Just reach us at pc@ncix.com, and you'll hear from us within 24 hours," Carroll says.

Within each tier, you have the ability to switch the processor, GPU (or GPUs), cooling, storage, and other extras, such as lighting. As the SOC Champion Edition is built on Intel's X99 chipset, your CPU options include Intel's three Haswell-E processors—the Core i7-5820K, the Core i7-5930K, and the flagship Core i7-5960X. That means, at a minimum, any SOC Champion Edition will have six cores with Hyper-Threading at its disposal.

When it comes to the GPUs, NCIX PC allows you to select among various flavors of GIGABYTE's GeForce 900 Series family. Your options include the GTX 960, 970, 980, and 980 Ti. If you want SLI on your rig, just click the drop-down menu next to your card of choice to double down on GPU power. NCIX PC can also liquid-cool the



NCIX PC can perform a variety of modifications to pimp out the SOC Champion.

GPU(s) using EK Water Blocks' elegant, top-shelf liquid cooling components for ultimate overclocking performance.

The default configurations for the SOC Champion feature both an Intel SSD 730 Series SSD (available in 240GB or 480GB capacities) and Seagate's SSHD Hybrid Drive (available in 1TB, 2TB, and 4TB capacities). Intel's SSD 730 Series delivers some pretty impressive throughput with sequential reads and writes of 550MBps and 270MBps (240GB)/470MBps (480GB), respectively. The SSHD technology in Seagate's storage identifies your most frequently-used files and stores them in NAND flash for better overall system responsiveness.

For system memory, NCIX PC starts you off with 16GB of Corsair Vengeance LPX DDR4-2666 memory, and you can upgrade the SOC Championship Edition to 32GB if you feel that 16GB will be insufficient for your needs. Corsair's HX850i powers the SOC Champion Edition, and you won't be wasting much power, because the PSU meets 80 PLUS Platinum certifications.

Get Ready To Do Battle

It's no surprise that GIGABYTE named the SOC Champion Edition its official eSports gaming machine, as even the most basic configurations are powerful enough to handle today's toughest games. The impressive hardware is complemented by an elegant design that exudes luxury. Take your game to the next level with the NCIX PC SOC Champion Edition. ■

Get To Know The Champ

At the heart of every SOC Champion Edition is GIGABYTE's GA-X99-SOC Champion motherboard. It's an overclocker's best friend, thanks to GIGABYTE's optimizations to the processor socket and memory trace paths, as well as the onboard buttons, switches, and voltage read points that make it easier to overclock your rig.

GIGABYTE provides a CPU socket with 2,083 pins, so the motherboard can utilize all of the contacts on Intel's Haswell-E processors. With 72 more contact points, you'll enjoy greater stability when overclocking. To boost memory speed, GIGABYTE uses SMT (surface mount technology) on the DIMM slots, which shortens trace paths to deliver faster communication with the CPU. The GA-X99-SOC Champion currently supports DDR4 memory rated for up to 3400MHz speeds.

The GA-X99-SOC Champion's got onboard gadgets and gizmos aplenty. You'll find the standard power, reset, and clear CMOS buttons, as well as a BIOS switch where you can move between the main and backup BIOS. This means the SOC Champion Edition has you covered for situations where you need to recover from a crashed BIOS. If you want to get real-time component voltages, the GA-X99-SOC Champion offers a host of read points where you can connect a multimeter, including read points for the DIMM slots and PCH.



LEPA EXllusion 240

Don't look now, but LEPA is making a hard charge into the world of liquid cooling. Just last month we examined the company's AquaChanger 240, a closed-loop liquid cooler with a lot of muscle. This month, LEPA sent us a CPU liquid cooler that's even more intriguing, the EXllusion 240.

The EXllusion 240 is the kind of CPU cooler that would make John Venn a happy man. It's decidedly not a closed-loop cooler, but we wouldn't call it a completely custom kit, either. Everything you need is included in the box, and the loop is pre-filled, too. In short, if you know how to open a box and turn a few screws, you can install the EXllusion 240, so in that regard it's as easy to set up as any closed-loop liquid cooler. The pump and waterblock are condensed into one unit, as well, which is another hallmark of closed-loop coolers.

Make no mistake, though, the EXllusion 240 just begs to be customized, and LEPA provides the materials for you to do so.

The pump/cold plate unit has a fill port that lets you add coolant as needed (LEPA provides a 500ml bottle in the box to refill the loop—you're welcome), but it also gives you an easy way to add dye to tint the coolant. And here, two and half paragraphs into our review, we arrive at the EXllusion 240's value proposition: completely custom coolant color. The EXllusion 240's tubing is clear, and LEPA includes a set of red, green, and blue dyes to use in the loop. That's almost 16.8 million possibilities! So, simply add 101 parts red, 156 parts green, and 239 parts blue to get that cornflower blue coolant you've always wanted. We jest, of course, but the prepackaged dyes and the EXllusion 240's fill port further extend the notion that this is one heck of an approachable cooler. An LED light built into the pump unit helps you show off your handiwork.

It makes perfect sense that, as a LEPA product, the EXllusion 240 borrows a lot of the same technology that made the

AquaChanger 240 such a solid cooler. The EXllusion 240's cold plate also uses LEPA's patented CDP (Central Diffusing Passage), but on this cooler there are two passages cut into the microfin array, as opposed to the AquaChanger 240's single passage. According to LEPA, CDP increases heat absorption while mitigating CPU hot spots. The included fans have the same dual convex blade design, as well. Despite their similarities, the EXllusion 240 has slightly greater cooling capacity (400W TDP) than the AquaChanger 240 (350W TDP).

To test the EXllusion 240, we used it to cool an Intel Core i7-5930K and then punished the pair with two CPU-intensive benchmarks: POV-Ray and Prime95. First, though, we let our processor idle for 10 minutes and took note of the CPU's temperature. During the idle period, the average temp across all six cores was 27.1 degrees Celsius, and at one point one of the cores peaked at 35 C. The EXllusion 240 stayed strong after five consecutive runs of POV-Ray, holding the average CPU temp to 50.7 C and a peak core temp of 55 C. Prime95's Small FFTs test, our nastiest test by far, raised the average CPU temperature to 60 C after running for 10 minutes; the peak core temp over this period was 65 C.

For power users who don't want to fuss with hand picking liquid-cooling components but nonetheless want their setup to stand out from the crowd, LEPA's EXllusion 240 is tough to beat. Priced to be competitive with a number of very good closed-loop liquid coolers that use 240mm radiators, this liquid cooler is a very compelling option indeed. ■

BY VINCE COGLEY

EXllusion 240

\$119.99

LEPA

www.lepatek.com

Specs: Materials: Copper (waterblock), aluminum (radiator); Socket compatibility: Intel LGA775/1150/1151/1155/1156/1366/2011(3), AMD AM2/AM2+/AM3/AM3+/FM1/FM2/FM2+; Pump: 3,000rpm; Fans: 2 x 120mm PWM (500 to 1,800rpm); Radiator dimensions: 32 x 274 x 120mm (HxWxD)

Test system specs: Processor: Intel Core i7-5930K; Motherboard: ASUS SABERTOOTH X99; GPU: ZOTAC GeForce GTX 980 AMP! Edition; RAM: Crucial Ballistix Sport DDR4-2400; Storage: 240GB Intel SSD 730; OS: Windows 8.1 Enterprise (64-bit)



be quiet! Dark Rock TF

In order to stay relevant in the increasingly competitive CPU cooling market, a company really needs to know what it's doing. This is doubly true for making air coolers. Simply adding more metal and faster fans only goes so far. It's obvious that German manufacturer be quiet! got the memo, because its Dark Rock TF heatsink-and-fan combo beats the heat by working smarter, not harder.

The Dark Rock TF is sizable, sure, but the cooler's real genius is the way be quiet! uses the space, so to speak. The key is the "TF" in the Dark Rock TF's moniker, which is short for "top-flow." Rather than latching onto either end of the heatsink like most coolers' fans, the 135mm SilentWings fans packaged with the Dark Rock TF lay flat across two beds of aluminum fins. This confers a couple of benefits. First, by blowing air toward the motherboard, the Dark Rock TF provides residual cooling to the motherboard components that surround

the CPU socket—capacitors and VRM circuitry in particular. Orienting the fans this way also offers the advantage of not adding extra width to the cooler's physical footprint, likely giving you more clearance for your system's memory modules. For example, there's 1.94 inches of space between the base of the Dark Rock TF and the bottom of the lower fan, well over half an inch more than the Dark Rock Pro 3's 1.37 inches of clearance.

Although we put an emphasis on how a manufacturer assembles the building blocks of an air cooler, the building blocks still matter. Those in the Dark Rock TF are first-rate. The heatsink's copper base is CNC-machined and polished to a mirror finish. There are six 6mm copper heatpipes that pass through the base and the top array of aluminum fins, while four of the six also pass through the heatsink's lower fins. Strips of

rubber line the top and bottom edges of the larger series of fins, helping to minimize fan noise once they're clamped to the heatsink.

The fans at work in the Dark Rock TF are worthy of mention, too. That pair of SilentWings fans use fluid-dynamic bearings with a copper core, and their six-pole motors run smooth to reduce turbulence. Even running at full speed (1,400rpm), the fans produce a mere 26.7dBA noise. In other words, we doubt you'll notice they're there.

So, on paper, the Dark Rock TF has all the makings of a—if you'll excuse the indulgence—rock-solid cooler. We tested it on a pair of rigorous benchmarks and found that it's a great performer in the real world. First, we left our Intel Core i7-5930K to idle for 10 minutes and then came back to take our processor's temperature; the average temp of our cores during the idle period was 28 degrees Celsius. When we turned on POV-Ray to turn up the heat, the Dark Rock TF acquitted itself well, maintaining an average core temp of 50.7 C and a peak of 57 C. Finally, we pushed the cooler to its limit by running Prime95's Small FFTs test for 10 minutes. This punishing benchmark raised the average core temperature to 61.7 C, and one of the 5930K's cores peaked at 68 C during the run.

Available for less than \$80, the Dark Rock TF is proof that air cooling ain't dead. With an excellent pair of fans and a thoughtfully designed heatsink, this is yet another CPU cooler from be quiet! that demands your consideration. ■

BY VINCE COGLEY

Dark Rock TF

\$79.90

be quiet!

www.bequiet.com

Specs: Materials: Copper (base, heatpipes), aluminum (fins); Fans: 2 x 135mm PWM (1,400rpm max); Cooler dimensions: 5.1 x 5.5 x 6.4 inches (HxWxD); Socket compatibility: Intel LGA775/1150/1155/1156/1366/2011(3), AMD AM2/AM2+/AM3/AM3+/FM1/FM2/FM2+; Warranty: 3 years
Test system specs: Processor: Intel Core i7-5930K; Motherboard: ASUS SABERTOOTH X99; GPU: ZOTAC GeForce GTX 980 AMP! Edition; RAM: Crucial Ballistix Sport DDR4-2400; Storage: 240GB Intel SSD 730; OS: Windows 8.1 Enterprise (64-bit)

**GTX 980Ti GAMING 6G**

\$679.99

MSI

us.msi.com

MSI GTX 980Ti GAMING 6G

MSI sent us its powerful GTX 980Ti GAMING 6G, which costs a cool \$320 less than the flagship Titan X but performs like it's got something to prove. This beast is going into our PAX Prime Sasquatch, making back-to-back MSI graphics-powered CPU System Workshop builds.

The GeForce GTX 980Ti features the GM200 Maxwell GPU with 8 billion transistors in a die that measures 601 square millimeters, manufactured using the 28nm process. There are 22 active streaming multiprocessor units in the GTX 980Ti's GPU, two fewer than the Titan X, for a total CUDA core count of 2,816. There are 176 texture units and 96 ROPs and, according to NVIDIA, this GPU's architecture delivers twice the performance-per-watt compared to the company's Kepler-based streaming multiprocessors.

There aren't many graphics cards that can claim to deliver playable framerates at 4K resolutions, but the GTX 980Ti is one of them, and it does so with the help of the

6GB GDDR5 frame buffer and the 384-bit memory bus.

MSI takes this impressive piece of hardware and straps its Twin Frozr V cooler to the top. It features an asymmetrical red-and-black shroud. Two 90mm Torx fans perform the card's primary cooling, and there's an LED backlit dragon logo on the top edge. The fans use a unique alternating blade design that mixes smooth straight blades with bulged blades to increase static air pressure and deliver better airflow. MSI's Zero Frozr technology stops the fans from spinning when the GPU is idle.

Four nickel-plated SuperSU Pipe heatpipes draw heat from the copper plate to the densely-packed heatsink fins. That cooling capacity comes in handy because MSI pushed the core clocks into uncharted territory. The bundled Gaming App lets you choose between three boost/base core clock modes, including OC Mode (1,279MHz/1,178MHz), Gaming Mode (1,228MHz/1,140MHz), and Silent Mode

Specs & Scores	MSI GTX 980Ti GAMING 6G
Core/Boost Clocks	1,279MHz/1,178MHz (OC Mode), 1,228MHz/1,140MHz (Gaming Mode), 1,076MHz/1,000MHz (Silent Mode)
Memory Clock	1,752MHz (1,775MHz OC Mode)
Memory Interface	384-bit
Memory	6GB GDDR5
3DMark Professional (Fire Strike Extreme)	7638
Graphics Score	7904
Physics Score	16174
Unigine Heaven 4.0 Score	1875
FPS	74.4
Games	1,920 X 1,080
Aliens VS. Predator (Very High, 16XAF, 4XAA, SSOA)	145.2
Metro: LL (DX11, Very High, 16XAF, Very High Tess.)	112.67
Dying Light (High, AO On, AA On, Vsync Off)	150.97
Witcher 3: Wild Hunt (Vsync Off, Unl. FPS, Ultra)	84.31

(1,076MHz/1,000MHz). OC Mode adds another 22.5MHz to the memory clock.

The graphics card is 10.5 inches long and requires two 8-pin PCIe power connectors. If you plan on running in OC Mode, avoid using a 6- to 8-pin PCIe adapter. Your PSU should be able to handle at least 600 watts of continuous power to run this 250-watt TDP card. On the back bracket, you'll find one Dual Link DVI-I port, an HDMI 1.4a/2.0 port, and three DisplayPort 1.2 ports.

We chose the middle-of-the-road Gaming Mode for our testing, which delivers great framerates in the games without pushing the fan above a barely audible hum. If you're looking for a winning take on the GeForce GTX 980Ti, MSI's factory overclocked version is the fastest we've tested. ■

BY ANDREW LEIBMAN

Specs: GPU: Maxwell GM200; Core Boost/Base Clocks: 1,279MHz/1,178MHz (OC Mode), 1,228MHz/1,140MHz (Gaming Mode), 1,076MHz/1,000MHz (Silent Mode); Memory Clock: 1,752MHz; Memory Bus: 384-bit; Frame Buffer: 6GB GDDR5; Factory Overclocked: Yes; Ports: dual-link DVI, HDMI, three DisplayPort
Test system specs: Processor: Intel Core i7-5960X; Motherboard: GIGABYTE X99-Gaming G1; RAM: 16GB Ballistix Elite DDR4-2400; Storage: 240GB OCZ Vertex 3 MAX IOPS SSD; OS: Windows 8 Enterprise (64-bit)



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Deepcool Gamer Storm TF 120

Deepcool's Gamer Storm lineup of products includes one case (the extremely cool Tristellar, which we covered in depth starting on page 51 of the July issue) but is mostly made up of CPU coolers and fans. The new Gamer Storm TF 120 is one of the latter that—as its name suggests—measures 120mm in diameter and that comes in three colors: red, white, and blue.

There are lots of varying fan designs out there, but the TF 120 has one of the most unique configurations we've seen to date. Deepcool refers to it as a "2-layer blade design," and it's easy to see why. Each of the nine blades on a TF 120 has a thin second layer that runs all along the rear edge of the blade about 1/8 of an inch above the main blade. (Come to think of it, it sort of looks like each blade has its own little spoiler.) Each "spoiler" is supported by

a couple of ridges that begin just behind the leading edge and then rise gradually until they meet the top layer just before the rear edge of the blade.

The two-layer blade design's purpose is to create greater airflow, and this is complemented by the shape and design of the fan's frame, which has a series of channels around each corner on the back side to neutralize the noise created by the increased turbulence.

The fan runs on a semi-hermetic fluid dynamic bearing with a MTBF of up to 100,000 hours and contributes to quiet operation by reducing friction. Also, the blade is detachable, which gives you more color options and makes the fan easier to clean. The TF 120's FDB mechanism is dust-proof and waterproof. It's also designed to prevent oil leakage.

The TF 120 has LED emitter lenses inside the frame at all four corners.

It's a PWM-controlled unit with an operating range of 500 to 1,800rpm; its power connector resides at the end of a black, braided-nylon power cable. Deepcool ships each TF 120 with a 4-pin PWM extension cable and a second extension that plugs into a 4-pin Molex connector.

These are solid, well-made LED fans that provide lots of airflow when you need it without generating a lot of noise in the process. They make a great addition to builds with all sorts of internal color schemes, thanks to the availability of three colors and interchangeable blades. ■

BY CHRIS TRUMBLE

Gamer Storm TF 120

\$16.99

Deepcool

deepcool.com

Specs: Dimensions: 120 x 120 x 26mm; Speed: 500 to 1,800rpm; Max airflow: 76.52cfm; Noise: 17.6 to 31.3dBA; Connector: 4-pin PWM; Extras: PWM extension cable, Molex 4-pin adapter



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Thermaltake SHOCK CONSOLE Gaming Headset

Gamers demand a lot from their headsets, but one area where most fall short is in the category of compatibility. As a result, we tend to have one headset for our gaming consoles and another for our PC. Thermaltake's SHOCK CONSOLE gaming headset is the company's valiant attempt to desegregate your gaming systems and unite them under one set of foam-lined ear cups.

The headset features a matte black rubberized finish on the outside of the cans and the headband, with red plastic plates surrounding the ear pads. There's also a red plush headband pad. Each side of the headset glows with red LED dragon logos. With lots of ambient light in the room, the logos have a rather pinkish hue, but in the dark, they appear a much richer shade of red. Both the flexible mic boom and the cord sprout from the left can and there's a black L and R indicator above each ear pad. This is a

stereo headset, even though the decoder box relies on USB and optical inputs.

As such, the Thermaltake SHOCK CONSOLE gaming headset supports PS3/4, Xbox 360/One, and PC gaming. If you plan to use this with the Xbox One, however, keep in mind you'll need an external stereo headset adapter, which Thermaltake doesn't supply. Microsoft recently updated the controllers with a native phono port, so these will be compatible with the SHOCK CONSOLE right out-of-the-box.

The foam ear pads are oblong in shape and covered in a breathable black mesh fabric. They'll rest on the outside edges of your ears, but the headset itself is light enough that extended gaming sessions don't make this uncomfortable. The headband is adjustable and we like that the headset mic is removable.

Under the plastic shell, this headset features a pair of 40mm drivers equipped

with neodymium magnets. The sound they deliver has a good amount of bass, but the mids and highs remain crisp and clear regardless of how much sound these puppies are pumping out. Another feature we like is the inline audio controller, which provides discrete volume dials for mic and game input—a must-have for multiplayer gaming scenarios. The unit also features a mic mute switch and a 2.5mm cable for plugging into the console game controllers. Crucially, there's just enough length to these wires that you won't be yanking the headset off in the heat of battle, yet short enough to make sure they don't get tangled easily. We do wish the inline audio controller box had a clip on it though.

When you factor in the price, the Thermaltake SHOCK CONSOLE makes a good case for itself as your next all-purpose gaming headset.

BY ANDREW LEIBMAN

Specs: Drivers: 40mm, 20Hz to 20KHz; Impedance: 32 ohm; Sensitivity: 98dB; Mic: 50Hz to 15KHz; Controller: chat volume, game volume, mic mute; Connector: USB; Extras: red LED-lit dragon logos, optical input decoder box

**Suppressor F51**

\$119.99

Thermaltake

www.thermaltakeusa.com

Thermaltake Suppressor F51

Thermaltake's Suppressor F51 is a mid-tower case designed with an emphasis on silent operation, and it draws on a few proven techniques to accomplish this goal. For starters, Thermaltake gives the case a solid front panel that has sound-deadening material fastened to its inside; the panel opens left to right, revealing a vented inner panel with a pair of removable dust filters in between you and a big 200mm intake fan. External air enters the case via baffled vents along the front edge of both sides, which helps deflect internal system noise that would otherwise come straight out toward you.

The case has similar sound-deadening material inside its right-side panel and (if you opt for the model with a solid side panel instead of the windowed panel our review unit arrived with) the left-side panel, as well as along the top panel. The top panel's insulation takes the form of three separate pieces that you can remove in the event that you decide that having a radiator installed beneath the top is a higher priority.

In addition to the pre-installed 200mm intake fan, the Suppressor F51 comes with a 140mm exhaust fan installed at the rear. The aforementioned front dust filters are joined by two more on the bottom of the case (one beneath the PSU mount and one toward the front) and a removable magnetic dust filter on top. The non-windowed version of the case comes with an additional magnetic dust filter on the outside of the left-side panel over an interior 140mm or 120mm fan mount.

The Suppressor F51's interior is highly configurable, in that all of its internal drive bays are removable. The two 5.25-inch bays at the top come out separately via screws in the rails in front, and you can remove the two three-bay cages for 3.5- and 2.5-inch drives by taking out four thumbscrews each. Taking all its bays out leaves a lot of room to work with for elaborate cooling loops or just about whatever else you might want to build into your rig, and you can still mount two 3.5- or 2.5-inch drives on the back of the motherboard tray, using one or two of the tool-less bays from the interior cages. Just pop

the bay out, fasten in your drive, and clip the bay to the side using the provided hooks.

Elsewhere, the Suppressor F51 has all of the features you'd expect from a high-end case; a motherboard tray equipped with a huge cutout for mounting coolers, rubber-grommited cable management holes in the appropriate locations, a PSU mount with rubber insulation pads at key locations to dampen vibration, and tie-down loops on the back of the motherboard for neater cable management. The case is nice and wide to accommodate all your building needs with ease, and the front-mounted ports and controls (including a pair of fan control buttons) are arrayed along the front edge of the top panel for easy access.

Thermaltake introduced the Suppressor F51 as a new case line, which suggests that there will be additional Suppressor models forthcoming. If the F51 is a good indicator of what to expect, this will be a product family to keep an eye on. ■

BY CHRIS TRUMBLE

Specs: Dimensions: 20.6 x 9.1 x 22.7 inches (HxWxD); Materials: SPCC steel; Motherboard support: Mini-ITX, microATX, ATX, EATX; Drive bays: 2 x 5.25-inch external, 6 x 3.5/2.5-inch internal; Fans (included): 1 x 200mm front, 1 x 140mm rear; Fans (optional): 3 x 120mm or 2 x 140mm front, 3 x 120mm or 3 x 140mm or 2 x 200mm top, 1 x 120mm rear, 1 x 140mm or 1 x 120mm side (non-windowed version only), 2 x 120mm bottom; Ports: 2 x USB 3.0, 2 x USB 2.0, audio I/O

**BattleHawk Black**

\$79.99

Aerocool

www.aerocool.us

Aerocool BattleHawk Black

At just 18 inches deep, the BattleHawk from Aerocool is on the small end of the mid-tower spectrum, but it supports ATX boards (as well as mATX and Mini-ITX ones), graphics cards up to more than 15 inches long, and full-sized power supplies, so there's no need to worry about skimping on components.

The 5.25-inch and 3.5-inch drive cages at the top and bottom of the front end are riveted in rather than fastened with thumbscrews. As a result, this case lacks the interior modularity that is increasingly popular in gaming cases, but removing the cages is a simple matter of drilling out the rivets that hold them in place. The good news is that one of the BattleHawk's two 2.5-inch drive mounts resides on the back of the motherboard tray, so you can remove the cages (leaving more space for cooling gear and

whatnot) and still have a great spot for an SSD boot drive.

One of the bays in the upper, 5.25-inch drive cage actually supports a 3.5-inch external drive. Aerocool's site points out that this bay can house an FDD or a card reader, which is a bit odd given that floppy drives are extinct and there's already an SD card reader mounted on top of the case. (There are also two fan control buttons and the usual selection of ports at the front of the top.) But the handsome front panel's door closes over this slot, meaning whatever you decide to use it for will be mostly your business.

Aerocool equips the case with a single 120mm red LED fan behind the front panel (there's room for a second if you want to add it), and the dark translucent bottom section of the front panel shows the LEDs' glow when the case is powered up. There's another 120mm

fan (no LEDs) preinstalled at the rear, and there are another two 120mm fan mounts beneath the top panel. Not coincidentally, you can opt for a 240mm double rad under the top panel, and of course the rear fan mount will accommodate a single rad.

Aerocool's BattleHawk Black is an apt answer to the question, "How much case can you get for \$80 these days?" It's also proof positive that budget-conscious cases don't have to be bland, square boxes; this case has a striking exterior shape and (for the most part) smooth, clean lines that result in a sleek, muscular look that contains just the right amounts of flash and restraint. Add its windowed left-side panel to the equation, and the result is an awful lot of case for a little money. ■

BY CHRIS TRUMBLE

Specs: Dimensions: 19.3 x 8.6 x 18 inches (HxWxD); Materials: Steel, plastic; Motherboard support: Mini-ITX, microATX, ATX; Drive bays: 1 x 5.25-inch external, 3 x 3.5-inch internal, 2 x 2.5-inch internal; Fans (included): 1 x 120mm LED front, 1 x 120mm rear; Fans (optional): 2 x 120mm, 1 x 120mm rear, 2 x 120mm top; Ports: 1 x USB 3.0, 2 x USB 2.0, audio I/O



Deepcool CAPTAIN 240

For a while, if you had seen one closed-loop liquid-cooler you had seen them all. Beneath their branding stickers, the vast majority of closed-loop CPU coolers had Asetek DNA. Sure, companies would tweak certain aspects, adding their own fans here or custom LED lighting there, but the underlying design was the same. Deepcool wants to give you something new to look at. Feast your eyes on the CAPTAIN 240.

We're not totally surprised to see a Deepcool component that distinguishes itself visually. After all, these are the same creative people who developed the innovative and unique Tristellar case (which we covered in last month's issue). The CAPTAIN's calling card is its pump-cold plate unit. It features a short section of clear hard tubing that shoots out of its top, makes a sharp bend to run parallel with the unit, and then disappears into a 90-degree elbow that's fused to the side of the unit. The clear tubing is

nominally practical, giving you a glimpse of the coolant as it flows through the loop, but it's mostly just there for looks—and we like the look. From the top down, the pump unit looks like the front of a jet turbine, and Deepcool's Gamer Storm logo appears on the sides where there isn't any connected tubing. All in all, it's a distinctive aesthetic that sets the CAPTAIN apart from other closed-loop liquid-coolers.

However, the CAPTAIN is more than a pretty face; Deepcool put a lot of thought into the cooler's guts, as well. The pump uses a closed impeller that generates more power without a corresponding increase in noise, and it has a three-phase induction motor for more forceful coolant flow. And thanks to a zirconia ceramic bearing, the CAPTAIN's pump has an expected life span of 120,000 hours.

The rest of the CAPTAIN's cooling components are similarly impressive.

The cold plate is pure copper (which should be a given at this point), and its internally facing side is lined with a dense cluster of 0.2mm fins, which greatly increase the cold plate's surface area. The two included 120mm fans are PWM and rely on a long-life Japanese fluid dynamic bearing. The outer edges of the fan blades have a series of grooves designed to optimize airflow, and you can detach the impeller from the motor for easier cleaning.

So, does the CAPTAIN deliver? We gave it a chance to prove its worth by letting it cool Intel's mighty Core i7-5930K. As always, we kicked off our testing procedure by taking temperature readings over a 10-minute idle period. Here, the average temp across all cores was 24.9 degrees Celsius, with a peak temperature of 37 C on one of the cores. Next, we pitted the CAPTAIN against POV-Ray, running the benchmark five times consecutively, and the cooler responded by holding the average CPU temperature to 44.4 C. The peak core temp during our POV-Ray test was 50 C. Finally, we ran Prime95's strenuous Small FFTs test for 10 minutes to fully tax the CAPTAIN. In this test, the average CPU temp was 54.4 C, and one core peaked at 61 C.

The CAPTAIN 240 is a solid, attractive offering from Deepcool. Don't have enough room for its 240mm radiator? The CAPTAIN 120 is designed for tighter spaces. Want a bigger rad? Go with the CAPTAIN 360. No matter what you're looking for in a closed-loop CPU cooler, Deepcool has it covered. ■

BY VINCE COGLEY

CAPTAIN 240

\$109.99

Deepcool

www.deepcool.com

Specs: Specs: Materials: Copper (waterblock), aluminum (radiator); Socket compatibility: Intel LGA 1150/1155/1156/1366/2011(3), AMD AM2/AM2+/AM3/AM3+; Pump: 3,400rpm; Fans: 2 120mm PWM (600 to 2,200rpm); Radiator dimensions: 27 x 274 x 120mm (HxWxD)

Test system specs: Processor: Intel Core i7-5930K; Motherboard: ASUS SABERTOOTH X99; GPU: ZOTAC GeForce GTX 980 AMP! Edition; RAM: Crucial Ballistix Sport DDR4-2400; Storage: 240GB Intel SSD 730; OS: Windows 8.1 Enterprise (64-bit)



Bigfoot Sighting

The party's over. As summer winds down and vacations wrap up, another nine months of tedium is imminent. Pencils, books, teachers' dirty looks—the whole depressing shebang. Those carefree days of waking up with nothing on the docket are over until next year, so hunker down and try to keep those care cups at least half full.

It's not all gloom and doom, though. There are a lot of things to look forward to, including pro football, college football, Canadian football, and maybe even arena football. A little gridiron action not your thing? Don't sweat it. The late days of summer and early days of fall are prime time for a handful of highly anticipated videogame launches, as well as the return of your Favorite TV Show (that isn't "Game of Thrones," "Archer," "Better Call Saul," etc.). There are reasons to go on living.

If you live in the Pacific Northwest, Canadian Southwest, or anywhere with easy access to an airport, perhaps the best way to kick off the 2015-2016 school year is with a late-season vacation to the Penny Arcade Expo, which is now known among its indigenous peoples as PAX Prime. A haven for gamers of all stripes, not merely the console and computer crews, PAX Prime has quickly become the largest event of its kind in the Western Hemisphere. It's kind of a big deal.

For the last few years, *CPU* has been a part of PAX Prime, and this year is no different. And, like previous years, we come bearing just one gift. But hey, it's a pretty nice gift: a custom gaming PC that is filled up with a whole lot of killer hardware. For PAX Prime 2015, we wanted a way to honor one of the legends



of area. He's a shy guy, so you might not have heard much from him in the last few years. But trust us, he's around. Watching. Waiting. The final *CPU* System Workshop build of the year pays tribute to an A-lister of American folklore.

We've named this system "Sasquatch," and you do not want to mess with it. Follow along with us as we bring this monster to life.

On The Hunt

We have our last system build, the Battle Box (see the July 2015 issue), to thank for making our processor pick for Sasquatch an easy one. That rig's Intel Core i7-5930K performed and overclocked so well that we elected to have it back for an encore. Part of Intel's Haswell-E family, the 5930K comes from a long line of distinguished silicon. To save you the

trouble of having to track down your July 2015 issue, here are the key facts: The Core i7-5930K is a six-core processor with Hyper-Threading, capable of juggling as many as 12 instructions at once. It cruises along at 3.5GHz, although we know from experience that it's capable of much, much more. Thanks to the 5930K's unlocked multiplier, going from "OMG" to "ZOMG" is a BIOS tweak or two away.

In order to help our 5930K realize its full potential, we relied on GIGABYTE's well-appointed GA-X99-UD3P. This board is armed to the teeth, with support for 4-way SLI or CrossFire (when paired with our 5930K), up to 64GB of DDR4 (at speeds up to 3,333MTps), ultra-high-speed M.2 and SATA Express storage interfaces, and more. Further, the motherboard's Ultra Durable construction



(2 ounces of copper in the PCB, long-life solid caps, PowIRstage ICs and IR digital power controllers) help it meet the demands of power users.

The graphics card in Sasquatch is one of MSI's renditions on the NVIDIA GeForce GTX 980 Ti, arguably the most powerful GPU that doesn't bear the name "TITAN." Specifically, our build uses the GTX 980TI GAMING 6G, which takes NVIDIA's already lightning-fast reference design and makes it even more electric. The base and boost clocks—which are 1,000MHz and 1,075MHz, respectively, on a vanilla GTX 980 Ti—are jacked up to 1,178GHz and 1,279GHz on the GTX 980TI GAMING 6G; an intermediate OC profile will give you more demure base and boost clocks of 1,140MHz and 1,228MHz. If that's

still not good enough for you, feel free to fire up MSI's Afterburner overclocking utility and aim even higher. With the card's highly capable Twin Frozr V cooler keeping the GTX 980TI GAMING 6G's on ice, why not give it a shot?

Sasquatch's DRAM comes to us from Crucial Memory. Our Core i7-5930K's quad-channel memory controller needs to be fed, so we served up four 4GB sticks of Crucial's Ballistix Elite DDR4-2666. With a speed of 2,666MTps and 16-17-17 timings, this kit gave our system a healthy amount of memory bandwidth, and the modules themselves look terrific, swathed in black anodized heat spreaders that have a nice military aesthetic that's not in your face. The fact that this memory kit works with Crucial's M.O.D.

utility, which lets you monitor memory temps and more, is pure gravy.

An Intel SSD 730 serves as our build's storage. We went with the 480GB version, because you really can't have too much storage. This solid-state storage is plenty fast, too, with reported sequential reads and writes of 550MBps and 470MBps, respectively. At a queue depth of 32, the 480GB SSD 730 is capable of random 4KB reads up to 89,000 IOPS and 4KB writes up to 74,000 IOPS. You shouldn't worry about burning out this SSD, either; Intel approached the SSD 730 series with a data center mentality, and as such, the 480GB SSD 730 has a write endurance of 70GB per day for five years, well beyond the typical daily use for end users.



Fractal Design supplied us with Sasquatch's case and power supply. The former is the Define S (our variant included a very nice, very large case window that perfectly showed off the rest of our hardware), a case with modern sensibilities. Fractal realizes that today's enthusiasts are saying "good bye" to 5.25-inch drives forever, so the company disposed of 5.25-inch bays on the Define S. Fractal didn't stop there, though. Also 86ed are all the traditional 2.5-inch and 3.5-inch drive bays; instead, you'll find several 2.5/3.5-inch drive mounts on the reverse side of the motherboard tray. What to do with all that empty space that the drive bay cages normally occupy? You could install some obscenely long graphics cards or perhaps a massive liquid-cooling reservoir. Whatever you decide, we have every confidence you'll put the Define S' roomy interior to good use. The top panel of the Define S lets you mount a radiator as large as 420mm (just make sure the combined thickness

of the radiator and fans is 55mm or less), while front panel lets you install rads up to 360mm of any thickness.

The Fractal Design Edison M 750W is as resourceful as its namesake. An 80 PLUS Gold-certified PSU, it's stocked with Japanese electrolytic capacitors rated to operate at up to 105 degrees Celsius, plus a mix of Japanese and Taiwanese solid polymer capacitors. The Edison M 750W's 4+4-pin ATX12V power cable measures 27.6 inches long, which made it easy to route the cable behind the Define S' motherboard tray and then plug the cable into the corresponding connector on our GA-X99-UD3P. A single 12V rail supplies a beefy 62 amps of current, and the rail itself has an impressively tight voltage regulation of $\pm 2\%$. Other niceties include a temperature-controlled 120mm fan with fluid-dynamic bearings, all sorts of built-in protections (overvoltage, overcurrent, short circuit, etc.), and a five-year warranty.

Sasquatch's CPU cooler is one you need to see to believe, but we'll do our best to do it justice. Of all the all-in-one liquid coolers we've encountered over the years, the LEPA EXllusion 240 has to be one of, if not the most, original. A set of dyes (red, green, and blue) is included with the cooler, which you can add to the coolant through the pump/cold plate unit's fill port to make your own custom color. And thanks to the EXllusion 240's G1/4 threaded holes, expanding the loop is no problem. Capable of dissipating 400W of heat, this cooler is no slouch, either; rest assured we'll put that capacity to good use when we overclock this machine's CPU.

Finally, we'll be sending Sasquatch out the door and to PAX Prime with some furniture. It sounds strange when we put it that way, but we can't imagine hearing many protests over the revelation that this particular piece of furniture is none other than a DXRacer King Series gaming chair. This luxurious seat has a higher back rest than most other chairs, supporting your back from rump to neck; call it "Lumbar Plus," if you will. King Series chairs have a five-point metal base with a gas spring, so it's definitely sturdy. We'd call it the Iron Throne of gaming chairs, but no King of the Seven Kingdoms has ever sat this comfortably.

Proof Of Existence

Although we've yet to see conclusive proof of the real Big Guy, our Sasquatch is anything but camera-shy. You can check out all the photographic evidence we've amassed for this monster, but if that's still not enough to convince you, feel free to hire your own camera crew and head to Seattle this August 28 through 31 to gather footage of your own. We'll even give you a chance to take the system back with you, because the only thing cooler than seeing this Sasquatch in person is winning it. ■





GIGABYTE

GA-X99-UD3P

Haswell-E has been obliterating everything in its path for months on end. When there's real, CPU-intensive work to be done, we can't think of a chip we'd rather have on our side than one of Intel's three current Core i7-59XX processors. In order to keep our build's Core i7-5930K humming along without issue, we had to have a motherboard from a company with a track record in reliability that's been unblemished in recent memory. Some overclocking chops wouldn't hurt, either. GIGABYTE's GA-X99-UD3P, with its ATX form factor to match our Fractal Design Define S case, is a perfect match.

Allow us to chronicle a few of the reasons the GA-X99-UD3P is as rugged as our system build's namesake. GIGABYTE populates the PCB from top to bottom with components engineered to handle heavy loads. The board's solid capacitors have a rated life span of 10,000 hours, well beyond standard solid caps. Server-grade chokes are littered across the GA-X99-UD3P; they're more than capable of handling high currents, and a new design minimizes heat due to power loss and efficiently feeds power to the board's VRM. The GA-X99-UD3P is built on a foundation of 2 ounces of copper—two 70µm-thick layers—for trace paths that can take on greater than normal power loads and for pulling heat away from the CPU power delivery area, both of which are vital for overclocking.

Despite not being part of GIGABYTE's G1 GAMING line, the GA-X99-UD3P will let you install one hell of a graphics subsystem. With a Core i7-5960X or i7-5930K, 4-way SLI or CrossFire is yours if you desire, and each of the mobo's four PCIe 3.0 x16 slots will operate at x8/x8/x16/x8. In a two- or three-card setup, the top two graphics cards can run at x16.



GA-X99-UD3P

\$198

GIGABYTE

www.gigabyte.us

This board is an almost surefire way to futureproof your storage subsystem. Both M.2 and SATA Express are present and accounted for (although the two share PCIe bandwidth, so only one interface can be active at a time), giving you access to throughput up to 10Gbps. Garden-variety 6Gbps SATA (10 connectors) is available as well, naturally.

But wait, there's more! In fact, there are so many cool features on the GA-X99-UD3P that a single page barely does them justice. (But we'll try.) EasyTune makes overclocking a fun, rather than intimidating, pursuit for beginners. Cloud Station Server can put your PC in the

palm of your hand, via smartphone; share and back up files from your mobile device, remotely control and monitor your system, and even power it down remotely. The GA-X99-UD3P's integrated audio is no slouch, and the integrated Intel Gigabit Ethernet controller uses cFos Speed, a network traffic management app that gives network priority to the programs (like games) you choose. Updated heatsinks and a customizable LED light path give the GA-X99-UD3P a nice look.

As X99 motherboards go, there's little the GA-X99-UD3P can't do. High-end hardware is welcome here; Sasquatch couldn't be the beast it is without this motherboard. ■

SPECS

Max memory: 64GB (DDR4-2133, DDR4-3333 max OC); Slots: 4 x PCIe 3.0 x16, 3 PCIe 2.0 x1, 1 M.2 (for optional Wi-Fi module); Storage: 10 6Gbps SATA, 1 SATA Express, 1 M.2 (supports type 2242/2260/2280); Rear I/O: 2 PS/2, 6 USB 3.0, 4 USB 2.0, 1 Gigabit Ethernet, 1 optical S/PDIF, audio I/O

**DXRACER**

King Series Console Gaming Chair (FS/KC57/NB/SUIT)

Walk into pretty much any mattress store and there's a good chance the salesperson will hit you with the bit of knowledge about humans spending a third of their lives sleeping, thus the need to buy the best mattress possible. While this is probably good advice in general, gamers routinely sacrifice sleep in the pursuit of competition and glory.

What's arguably more important to someone who logs hour after intense hour gaming is maximum comfort and support in terms of sitting and posture, whether he's doing so in front of a PC or a console system. Such comfort and adaptability is exactly why we made space for DXRacer's King Series Console Gaming Chair FS/KC57/NB/SUIT in front of our PAX Prime build.

Aesthetically, the chair-and-footstool combo the King Series FS/KC57/NB/SUIT bears the same sleekness and stylistic flair that typify other DXRacer gaming chairs—traits that stem from the company's heritage of manufacturing race car seats. The King Series FS/KC57/NB/SUIT also typifies the high-quality construction and sturdiness we expect from DXRacer chairs, including its use of top-notch, imported polyurethane material and cushioning for the chair and footstool and the use of computerized embroidery for the unit's lettering.

The King Series FS/KC57/NB/SUIT's full-sized, all-steel frame is built on a new five-point base that's crafted from solid silver aluminum rated to support more than a ton of weight. The base connects to a hydraulic unit DXRacer imports from Germany that meets numerous international build standards. The chair's adjustable armrests, meanwhile, are crafted from polyurethane. Overall, the chair's adjustable system enables a full 360-degrees



swivel, as well as 150-degree angle adjustments for the backrest that are controlled via a handy lever under the seat. The footstool is also adjustable and sturdy enough to serve as a separate seat. It's important to note that King Series Console Gaming Chairs sit lower to the floor than the company's PC gaming chairs and don't have adjustable height, so if you are looking for a chair to use with a fairly tall desk, one of the company's other models might be your best bet.

The King Series FS/KC57/NB/SUIT's backrest is designed to support the entire spinal column and ward off stiffness, muscle cramps, and other discomfort that can set in

after long gaming sessions. The removable headrest and lumbar cushions must pass 72 quality tests and carry a two-year warranty; you can adjust them up and down to provide further comfort.

To get a feel for what the chair and footstool offer comfort-wise, give the King Series FS/KC57/NB/SUIT a try for yourself at our PAX Prime booth. ■

King Series Console Gaming Chair (FS/KC57/NB/SUIT)

\$499

DXRacer

www.dxracer.com

SPECS

Color: Black and blue; Cover: PU; Armrests: Adjustable; Base: Silver aluminum; Weight limit: 300 pounds (chair), 265 (foot stool); Accessories: Headrest cushion and lumbar cushion



FRACTAL DESIGN

Define S

“Less is more” is a dominant theme among products that follow the minimalistic approach to design. Anyone familiar with the PC cases that Swedish maker Fractal Design creates can relate. With the company’s mid-tower Define S, however, “less is more” takes on expanded meaning.

Specifically, Fractal Design forgoes certain design aspects generally considered standard in modern cases with the Define S. By doing so, the Define S offers considerable space in which to get creative, especially where things like liquid cooling are concerned. How Fractal Design frees up more space is noteworthy and arguably provides a glimpse at where PC case design is headed. Combine all these factors and the Define S impresses us so much we made it the foundation of our PAX Prime build.

Initially, the Define S doesn’t seem to deviate much from previous Define cases, as it portrays the same strong but silent type as its predecessors with its durable construction, familiar stealthy black exterior, and clean lines. As with other Fractal Design cases, you’ll also find removable ModuVent panels on the top, chrome and rubber case feet on the bottom, and the use of various sound-absorbing design touches in between. Additionally, the Define S is available in either solid or windowed side-panel versions.

What distinguishes the Define S is what it doesn’t include. Namely, 5.25-inch optical drive bays are nowhere to be found. In this age of increased streaming and cloud services, this trait will likely become more common. An equally notable and impactful omission here is the absence of the internal top-to-bottom metal drive cages generally standard in modern cases.



Beyond simply creating more space, these design elements enable a straight front-to-back airflow path if opting for air cooling (two Fractal Design Dynamic GP-14 140mm fans are included). If going the liquid cooling route, you’ll find that you have numerous radiator-mounting possibilities, including support for up to 420mm radiators mounted at top (after removing the ModuVent covers), up to 360mm at the case’s front, and up to 120mm at the bottom or the rear. In addition to pre-drilled holes on the bottom panel, Fractal Design integrates adjustable mounting brackets where the drive cages would otherwise sit.

So, where do your drives go exactly? In a brilliant bit of engineering, Fractal Design integrates mounts on the back of the motherboard tray for two SSDs. In the area immediately in front of the motherboard

tray are mounts for another three HDDs or SSDs, and some clever cable management makes it easy to hide drive cables behind the motherboard tray. All this is easily accessible via the removable right-side panel, and rubber grommets are integrated to dampen vibration.

A major objective with the Define S is silence, something the “S” in its name suggests. The innovative design Fractal Design incorporates concerning drive placement, generous liquid-cooling options, and sound-dampening material all delivered with a stately appearance are worth inspecting up close, which we encourage you do at our PAX Prime booth. ■

Define S

\$79.99 (\$89.99 w/window panel)

Fractal Design

www.fractal-design.com

SPECS

Dimensions: 17.8 x 9.2 x 20.5 inches (HxWxD); Materials: Steel, plastic; Motherboard support: Mini-ITX, microATX, ATX; Drive bays: 3 x 2.5/3.5-inch internal, 2 x 2.5-inch internal; Fans (included): 1 x 140mm front, 1 x 140mm rear; Fans (optional): 2 x 140mm or 3 x 120mm front, 3 x 120mm/140mm top, 1 x 120mm/140mm bottom, 1 x 120mm/140mm side; Ports: 2 x USB 3.0, audio I/O



LEPA

EXllusion 240

As a busy builder, sometimes you don't always have the time to go all out with a custom liquid cooling loop. A closed-loop liquid cooler is a great option in this scenario, but what if you also want your CPU cooler to have a little personality? After all, if you go with a Warbucks Industries SuperCooler, it's going to look the same as every other SuperCooler—not exactly the best way to stand out at a LAN party.

LEPA has the perfect solution: the EXllusion 240, a liquid-cooler that's easy to install and arguably even easier to customize. You see, the EXllusion 240 comes out of the box just like a typical closed-loop liquid cooler. The tubing is already connected to the pump/cold plate unit and the waterblock, so all you need to do to install everything is set up the CPU socket mounting bracket, attach the fans to radiator, and screw in the rad and pump/cold plate unit. If you're handy with a Phillips screwdriver, we reckon you can blaze through the installation from start to finish in under five minutes.

Notice that fill port at the top of the pump-cold plate unit? Welcome to Customization Point No. 1. Oh, it's a regular fill port, alright, making it easy to top up your coolant if you notice it's running low, but it's also where you can add any combination of the red, green, and blue dyes that LEPA includes with the cooler. In no time at all, you can create a truly unique tinted coolant, and the EXllusion 240's clear tubing shows it off to the world.

Customization Point No. 2 is slightly more subtle, but we'd argue that it's just as important. LEPA uses G1/4 threaded holes for the EXllusion's fittings, which means that this liquid cooler is also expandable.



(So in truth, even though the EXllusion 240 looks like a closed-loop liquid cooler, it's anything but.) If you decide down the road that you'd like to add your graphics card to your loop, you don't need to chuck the EXllusion and start from scratch. Maybe you see a larger radiator in your future; nothing's stopping you from swapping this rad out when the time is right.

There's also some impressive tech on display. The EXllusion 240's cold plate features LEPA's patented CDP (Central Diffusing Passage) to help the coolant

absorb heat, and the fans' dual convex blade design increases airflow and static pressure according to LEPA.

As tempting as it was to break into the dyes and create a CPU-exclusive coolant for Sasquatch, we're leaving it unadulterated. Why? We picked the parts; let the winner pick the color. ■

EXllusion 240

\$119.99

LEPA

www.lepatek.com

SPECS

Materials: Copper (waterblock), aluminum (radiator); Socket compatibility: Intel LGA775/1150/1151/1155/1156/1366/2011(3), AMD AM2/AM2+/AM3/AM3+/FM1/FM2/FM2+; Pump: 3,000rpm; Fans: 2 120mm PWM (500 to 1,800rpm); Radiator dimensions: 32 x 274 x 120mm (HxWxD)



FRACTAL DESIGN

Edison M 750W

There's a long-standing debate in some quarters as to whether Edison or Tesla was the greater scientist, but there's very little question that Fractal Design knows how to make a great PC power supply. That's why once we decided on a Fractal Design case for our PAX Prime system build, asking them to throw in a PSU made perfect sense, and Fractal happily agreed.

The company's Edison line of power supplies consists of four models ranging in rated output from 450 watts to 750 watts, and each of them is 80 PLUS Gold-certified, meaning that they are up to 90% efficient at 50% load. Our 750W unit is also semi-modular like all Edisons, having just its main 24-pin ATX cable, two 6+2-pin PCIe cables, and an 4+4-pin 12V cable permanently attached. Speaking of the 4+4-pin cable, Fractal is looking out for builders, and makes this extra-long so that you can comfortably reach your board's CPU power socket from behind the motherboard tray, even in cases with bottom PSU mounts.

In the Edison M's box, you'll find an EPS12V 8-pin modular cable, as well as two more 6+2-pin PCIe cables, two peripheral cables, and three SATA cables, each with multiple connectors.

Like all Fractal PSUs, the Edison 750W has a great-looking black-and-white exterior. Its white 120mm fan on one side and distinctive stamped snowflake insignia on the other make it clear where the Edison 750W came from, and its flat, all-black cables ensure that it will blend into the interior of your case nicely, where it will be seen and not often heard. (The fluid dynamic bearing fan is temperature controlled, so it only ramps up to full



speed when the time is right, and even then will run fairly quietly.)

The Edison M 750W is outfitted with Japanese electrolytic capacitors rated at 105 degrees Celsius, and comes with the standard complement of protection tech for your precious components (overpower, overvoltage, short circuit, undervoltage, overcurrent, and overtemperature). Naturally, it's fully compliant with Intel Haswell C6 and C7 operation states.

In short, our build's Fractal Design Edison M 750 PSU is stylish, quiet, and dependable. Fairly un-Sasquatch like, really, but the opportunity to pair a quality unit like this with a case from the same company was not one we intended to miss.

We installed our Edison with the intake fan facing the bottom panel, where the Define S has very capable ventilation and is equipped with an easily removable dust filter. This helped keep the PSU's ambient interior temps low, and as advertised, the Edison M made barely a peep, even under substantial loads and while powering one of the most powerful CPUs and the most powerful non-TITAN GPU on the market. ■

Edison M 750W

\$119.99

Fractal Design

www.fractal-design.com

SPECS

Rated continuous: 750W (at 40 C); +12V rails: 1 (62A); +5V max: 20A; +3.3V max: 20A; SLI/ CrossFire-ready: Yes; Efficiency rating (advertised): 80 PLUS Gold; Connectors: 1 24-pin, 2 EPS 4+4-pin, 6 PCI-E 6+2-pin, 10 SATA, 5 Molex; Length: 6.3 inches; Warranty: 5 years

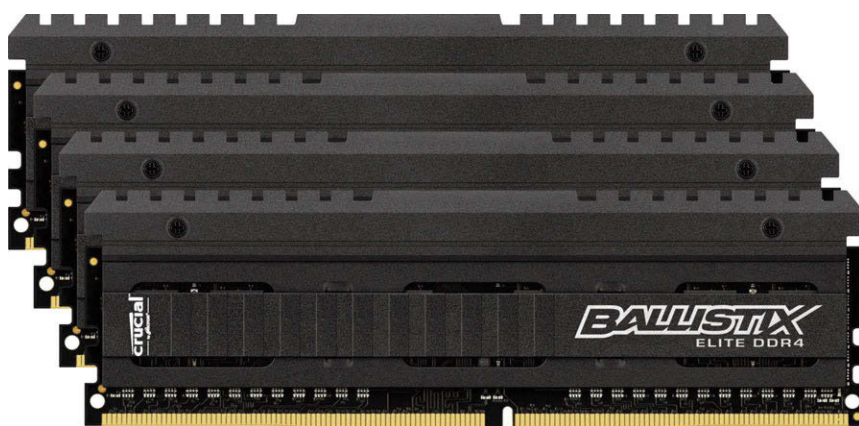

CRUCIAL

Ballistix Elite DDR4-2666 16GB

With an imposing name like Ballistix Elite, you know that this 16GB DDR4 memory kit is ready for some hardcore gaming at PAX Prime. Crucial, of course, backs up the bullish name with speedy 2,666MTps (megatransfers per second) modules that operate at DDR4's recommended 1.2V. And because our build is based on Intel's X99 chipset, we opted for a quad-channel kit that let us take full advantage of X99's extra memory bandwidth. The Ballistix Elite DDR4-2666 16GB surely checks all the performance boxes, but there's more to kit than meets the eye.

Crucial embeds a thermal sensor into each module, and when paired with the Ballistix M.O.D (Memory Overview Module) utility, you can monitor temperatures in real time. The thermal readings are ideal for extreme overclockers that require precision information about each modules' temperature, because you won't have to use taped-on temp sensors to see temperature readings.

The M.O.D. utility can also log memory temps, so you can monitor how readings fluctuate over time. This way, you can find temperature spikes and correlate which applications pushed your system memory the most. If temperatures go above thermal limits, M.O.D. can also send an alert to your Desktop. You'll just need to set the temperature limits in the utility. M.O.D. can also inform you about what's inside each module. Just open up the SPD Data tab to see the number of



banks and ranks, as well as the memory bus width.

The Ballistix Elite DDR4 2666 16GB kit operates at timings of 16-17-17-36, and we used the embedded Intel XMP to quickly load the optimized speed and timings. The fairly tight timings help to reduce memory latency, when compared to similar speed DDR4 kits that use slower timings, which help to provide an overall more responsive PC.

The basic black look is another thing we liked about the Ballistix Elite DDR4 2666 16GB modules, because the neutral color will match most any build. In our Sasquatch build, the dark DIMMs certainly partner up well with black PCB on GIGABYTE's GA-X99-UD3P and the

black backplate on MSI's GTX 980TI GAMING 6G.

Enthusiast memory, which is certainly where Crucial's Ballistix Elite DDR4 2666 16GB fits, is a competitive arena. And yet, Crucial's Ballistix Elite stands out as the clear choice for our build. The ability to monitor temps in real time, as well as log temperatures during benchmark testing, is a something you won't see on many memory kits. And because the performance is solid, as well, the only thing we had to really consider is what capacity we wanted to use. ■

Ballistix Elite DDR4-2666 16GB

\$255.99

Crucial

www.crucial.com

SPECS

Capacity: 16GB (4 x 4GB); Timings: 16-17-17-36; Frequency: DDR4-2666; Voltage: 1.2V; Unbuffered; Non-ECC; Warranty: limited lifetime



MSI

GTX 980Ti GAMING 6G

Although film of Sasquatch is notoriously fuzzy and blurry, the video delivered by the Sasquatch we're giving away at PAX Prime will have no such problems. With MSI's GTX 980Ti GAMING 6G in tow, the rig should have no trouble with true 4K gaming, thanks to the card's 6GB GDDR5 frame buffer and massive 2,816 CUDA cores. We also like that MSI employs a healthy factory overclock (up to 1,178MHz core and 1,279MHz boost), which elevates performance by 19%. The lucky winner of the Sasquatch build can expect some seriously great gaming with NVIDIA's latest Maxwell-based GPU.

MSI offers three levels of performance on the GTX 980Ti GAMING 6G, and you can quickly switch among the performance modes using MSI's Gaming App. We found the Gaming App to be a handy way to increase gaming prowess when necessary, while reducing power and noise for everyday work. In Silent mode, the GTX 980Ti GAMING 6G runs at a 1,000MHz core clock and 1,076 boost clock. The Gaming mode bumps the core and boost clocks to 1,140MHz and 1,228MHz, respectively, and there's an OC mode that pushes clock speeds to 1,178MHz and 1,279MHz, respectively. The OC mode also raises the memory clock speed from 1,752MHz to 1,775MHz.

The GTX 980Ti GAMING 6G's aggressive factory overclock is possible, in part, due to MSI's Twin Frozr V cooler. This red-and-black plastic shroud features two Torx fans with a unique airflow-increasing design. The Torx fan mixes dispersion blades (a raised ridge that scoops more air) with conventional

smooth straight blades to improve airflow without raising drag and increasing noise. Within the shroud, MSI uses its Airflow Control design to deflect airflow toward the heatpipes to more effectively siphon heat from the GPU. Best of all, the Twin Frozr V fans only start spinning once the temperatures reach above 60C, so the GPU should be quiet during idle.

MSI's Gaming App is more than just a way to tune the GPU's performance to your needs. There's also an Eye Rest capability that lets you set up dedicated color profiles for gaming, movies, and Eye Rest modes. The latter reduces the blue light balance, which should help lessen fatigue when gaming in the dark. The Gaming App also lets you control the card's ambient LED effects, such as breathing, flashing, and random.

For video outputs, MSI includes three DisplayPorts, one DVI-I port, and one HDMI port. The DisplayPort outputs support a maximum resolution of 4,096 x 2,160 at 60Hz, while the HDMI port maxes out at a resolution of 4,096 x 2,160



at 24Hz (it can handle 60Hz at 3,840 x 2,160). The DVI-I output supports a display resolution of 2,560 x 1,600 at 60Hz. With such a wide variety of outputs, you should have no problem connecting the GTX 980Ti GAMING 6G to your displays.

MSI's GTX 980Ti GAMING 6G is far and away from a reference GTX 980 Ti card. And MSI has the cooling technology to make sure that Sasquatch won't be overheating anytime soon. That's important, because we don't think PAX Prime attendees will appreciate us bringing in a hot, smelly Sasquatch—either the PC or Bigfoot variety. ■

GTX 980Ti GAMING 6G
\$679.99 | MSI | us.msi.com

SPECS

GPU: 28nm GM200 Maxwell; Clocks: 1,000MHz/1,140MHz/1,178MHz core, 1,076MHz/1,228MHz/1,279MHz boost; Memory clock: 1,752MHz/1,775MHz; Memory bus: 384-bit; Frame buffer: 6GB GDDR5; Factory overclocked: Yes; Ports: 3 DisplayPort, Dual-link DVI-I, HDMI



INTEL

SSD 730 Series 480GB

There is a long and formidable list of reasons why we choose to use the 480GB SSD from Intel's SSD 730 Series to meet our storage purposes with our PAX Prime build. (A 240GB model is also available.) Right at the top of the list is arguably the most important factor and one that Intel itself uses to describe this remarkable solid-state drive. Specifically, the drives belonging to the SSD 730 Series bring together enthusiast-grade SSD performance with the endurance and dependability one would have previously had to likely make a trip to a data center to find.

The appreciated marriage of speed and reliability that Intel pulls off translates into an SSD that provides exceedingly fast SSD performance enthusiasts crave and the data center-level endurance and reliability that enterprise business rely on and that any smart consumer should desire if obtainable. Making such endurance and reliability obtainable in a consumer 2.5-inch SSD is exactly what Intel has accomplished with the SSD 730 Series. While it might cliché say, the SSD 730 Series really does provide the best of both storage worlds.

Broadly, the SSD 730 Series presents storage that's equally capable of fulfilling a wide range of demanding storage tasks, including those associated with high-end gaming systems and workstations built for video editing and other digital content creation applications. Though it almost goes without saying, the SSD 730 Series is seemingly more than up to any storage tasks that's likely to surface in a home or office environment.

To create the SSD 730 Series drives, Intel relied on its own third-generation SSD controller and 20nm NAND flash memory.



The company also tapped its own firmware, which is optimized for performance. Both the SSD controller and NAND memory are overclocked within Intel's factory before shipping. Those overclocks push the controller's speed up an added 50% and the NAND bus speed an additional 20%.

These performance bumps result in 50µs read latency, as well as up to 550MBps sequential reads and 470MBps writes. Random reads and writes, meanwhile, come in at an impressive 89,000 IOPS (read) and 74,000 IOPS (write). Further, Intel claims performance will scale up nicely when connecting two SSD 730 drives in a RAID 0 configuration thanks to the company's Intel's Rapid Storage Technology.

In terms of endurance, the drive is stated as being able to take on more than 70GB of writes per day over the course of five years.

Put another way, that's more than three times the 20GB of writes per day that's common for other SSDs over the same five-year stretch. Either way, this type of endurance amounts to outstanding reliability and performance, whether you're dealing with compressible or incompressible data.

The SSD 730 drives comes with a five-year warranty, which itself is impressive. Combine this will stellar performance, endurance, and reliability and our PAX Prime build is benefiting from SSD storage that won't require its winner to compromise in any way. ■

SSD 730 480GB

\$299.99

Intel

www.intel.com

SPECS

Sequential read/write (advertised): 550MBps/470MBps; Max 4K random read/write (advertised): 89,000 IOPS/74,000 IOPS; Interface: 6Gbps SATA; Warranty: 5 years



INTEL

Core i7-5930K

If you believe one report, Intel's next generation of Extreme Edition processors, code-named "Broadwell-E," won't arrive until early next year. If you believe a different report, Broadwell-E might be skipped altogether, while Intel focuses on prepping Skylake-E for release sometime in the latter half of 2016.

That leaves Haswell-E to continue wearing the crown as the preeminent desktop processor architecture for the foreseeable future, and you know what? We're OK with that. Why? Because Intel's current HEDT (high-end desktop) chips were awesome when they launched last year, they're awesome now, and they'll continue to be awesome for quite some time. Waiting for the next meal is a nonissue when the current meal is still so delicious.

The entrée before you is the Core i7-5930K, which plays second fiddle to Intel's Core i7-5960X; in any other orchestra, this processor would be the concertmaster. Built on Intel's 22nm process, the Core i7-5930K has six physical cores and Hyper-Threading, giving it the ability to plow through workloads, 12 simultaneous instructions at a time. The processor has a standard clock speed of 3.5GHz, and by default it can dynamically increase its speed to 3.7GHz when a little more oomph is needed.

With the right CPU cooler, though, the Core i7-5930K is capable of much more. For this build and the last, we were able to overclock the 5930K to 4.5GHz after increasing its voltage to 1.3V. This had a significant impact on any benchmark that emphasizes CPU performance.

The Core i7-5930K's on-die memory controller does wonders for memory



bandwidth, too. By default, the controller supports up to 64GB of DDR4-1333/1600/2133, but it's the controller's ability to address four channels at the same time that really makes it shine. Combined with a kit of four Crucial Ballistix Elite DDR4-2666 modules, our system turned in results of 44.7GBps and 45.92GBps in SiSoft Sandra 2015's Integer and Floating Memory Bandwidth tests, respectively.

Although we rarely classify CPUs as "gaming processors," it's nonetheless fair to say that the Core i7-5930K is a choice

chip for avid gamers, and it has nothing to do with processing power. You see, with 40 PCIe 3.0 lanes at its disposal, the 5930K lets you run 4-way CrossFire/SLI setups and feeds each ample amounts of PCIe bandwidth.

You could play the waiting game and hold out for Intel's next-generation high-end CPU. Or you could get a Core i7-5930K and start dominating right now. It's not a difficult decision, people. ■

Core i7-5930K | \$594 | Intel | www.intel.com

SPECS

Clock speed: 3.5GHz (base), 3.7GHz (turbo); 6 cores; Unlocked multiplier; Socket LGA2011-v3; Quad-channel memory; 15MB Intel Smart Cache; Hyper-Threading; Turbo Boost; 22nm; 140W Max TDP



Benchin' With Sasquatch

Setting up shop at an event that has hosted over 70,000 attendees in the past, we know that there are bound to be quite a few very discerning power users stopping by to scope out our PC building skills. Needless to say, we always try to bring our “A” game when creating our system for PAX Prime. Sasquatch is no exception.

Bigfoot is well-known for his . . . let's say, passionate disregard for personal grooming. Our Sasquatch, on the other hand, is all clean, kempt, and ready to party. Fractal Design's Define S plays a big role in this, of course, as Fractal cases so often do. Thanks to the case's jumbo side panel window, our build's tidy interior is easy to see. Further, working with such a wide-open, builder-friendly case helped us install all of our hardware without running into any snags, hangups, or gotchas.

You can clearly see all that empty space toward the front of the Define S. The lack of drive bays is a bit of a shock at first, but once you consider all the possibilities you now have with that open space, we highly doubt you'll miss them. When the winner of Sasquatch is ready to upgrade to an all-encompassing liquid cooling setup, there's have plenty of room to do it.

Not that this rig's cooling needs an upgrade, necessarily. We gave the LEPA EXllusion 240 all-in-one liquid CPU cooler and chance to shine, and it didn't disappoint. After performing all of our stock benchmarking, we jumped into the GIGABYTE GA-X99-UD3P's BIOS and gave our Intel Core i7-5930K a healthy overclock. Like last month, we dialed in a 4.5GHz operating frequency for the



processor and boosting the Vcore to 1.3V in order to handle the 28.6% higher clock speed. The EXllusion 240 handled it like a pro. Yes, CPU temperature did cross the 80 degrees Celsius threshold a few times, but our system remained stable. It's possible we

could've pushed the processor a little further, but we like to take a conservative approach with these builds.

This angrier, faster, and more powerful Sasquatch rampaged through our benchmarks one more time, posting massive

SPECS

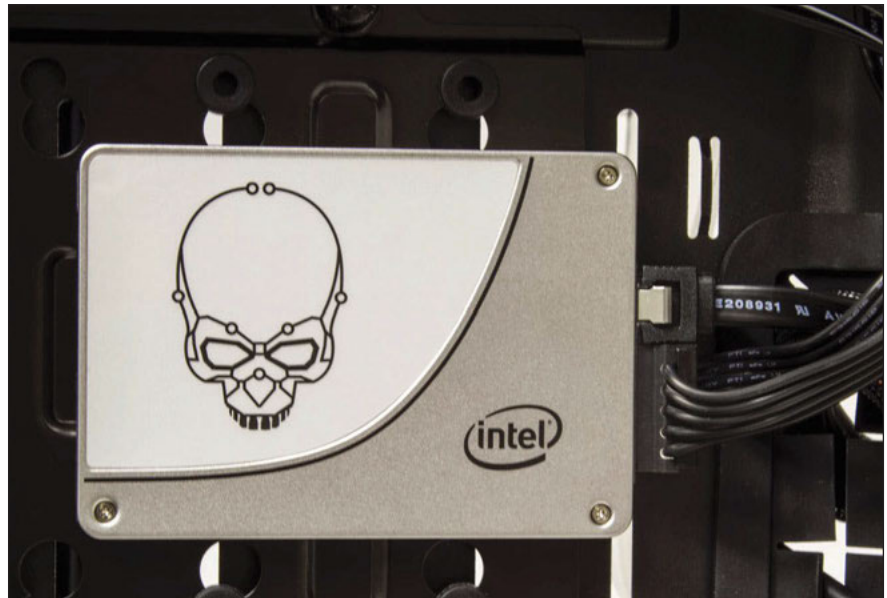
Processor: Intel Core i7-5930K; Motherboard: GIGABYTE GA-X99-UD3P; Graphics card: MSI GTX 980TI GAMING 6G; RAM: 16GB Crucial Ballistix Elite DDR4-2666; Storage: 480GB Intel SSD 730; PSU: Fractal Design Edison M 750W; CPU cooler: LEPA EXllusion 240; Case: Fractal Design Define S - Window; OS: Windows 8.1 Pro



gains in any test that focused on CPU performance. Notice the 21% improvement in Cinebench and the 23% boost to POV-Ray, for example.

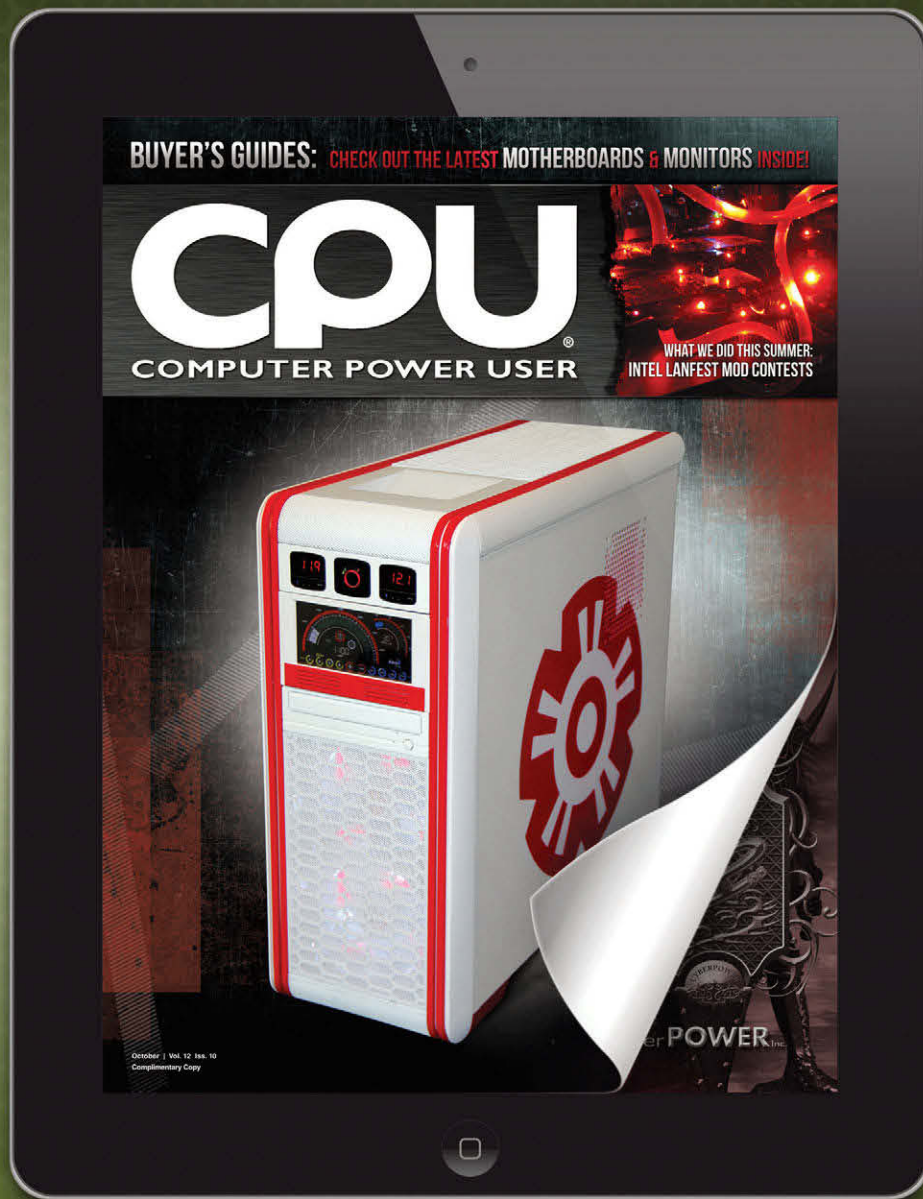
The factory-overclocked GeForce GTX 980 Ti will flirt with 4K performance in even the most demanding games. Our average frame rate only dipped below 70fps once in all of the games we tested (at 2,560 x 1,600, with settings turned way up), so we're confident that 4K gaming isn't an unreasonable demand.

We'll be sad to see Sasquatch go, but we know that he'll be headed to a good home. Plus, the chance to work with so many killer components is its own reward. Come back next year when the *CPU System Workshop* opens again, and see what monsters we're able to create. ■





Benchmark Results	Sasquatch (stock)	Sasquatch (4.5GHz)
3DMark Fire Strike	8244	8388
Graphics Score	8698	8691
Physics Score	14365	17767
PCMark 8		
Creative Score	4974	5488
Cinebench 15	1073	1297
POV-Ray 3.7 Beta (pixels per second)	2228.95	2749.47
SiSoftware Sandra 2015 Lite SP2		
Dhrystone AVX2 (GIPS)	235.69	293.45
Whetstone AVX (GFLOPS)	148.24	185.25
Multi-Media Integer x32 AVX2 (Mpixels per second)	365	447
Multi-Media Long-int x16 AVX2 (Mpixels per second)	175.7	218.88
Multi-Media Quad-int x1 ALU (Mpixels per second)	2.76	3.44
Multi-Media Single-float x16 FMA	354.15	417.49
Integer Memory Bandwidth B/F AVX/128 (GBps)	44.7	45.15
Floating Memory Bandwidth B/F AVX/128 (GBps)	45.92	46
CrystalDiskMark 5 (MBps)		
Sequential Q32T1 Read	559.2	562.6
Sequential Q32T1 Write	509	510.6
4K Q32T1 Read	356.8	357.6
4K Q32T1 Write	315.4	315.2
Sequential Read	462.8	461.8
Sequential Write	486.6	472.5
4K Read	30.78	30.23
4K Write	76.72	79.21
Games (2,560 x 1,600)		
Aliens vs. Predator (Very High, High Shadows, SSAO, 4XAA, 16XAF)	86fps	88fps
Metro: Last Light (DX11, Very High, 16XAF, Very High Tessellation)	80.33fps	83.2fps
Dying Light (Med, AO On, AA On, Vsync Off)	89.72fps	96.29fps
Witcher 3: Wild Hunt (Vsync Off, Unl. fps, Ultra)	70.61fps	68.72fps



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Intel LANFest 2015

April Showers Bring May, June & July LAN Parties

Intel LANFest DESERTBASH mini-BASH 4

You'll find Intel's Fab 32 on the southeast corner of the Phoenix, Ariz., metro in a town called Chandler. That's also where you would have found DESERTBASH mini-BASH 4 if you'd showed up on Saturday, May 16 from 10 a.m. to 8 p.m. This is the second mini-BASH event this year, and the tiny but rockin' 52-seat BYOC event had a waiting list nearly as large as its total capacity by the time the doors opened. This is hardly surprising, given that the 10-plus-hour event cost just \$10 (all proceeds were donated to Child's Play) and included a few tournaments, a bunch of network freeplay, some console gaming, and some great contests.



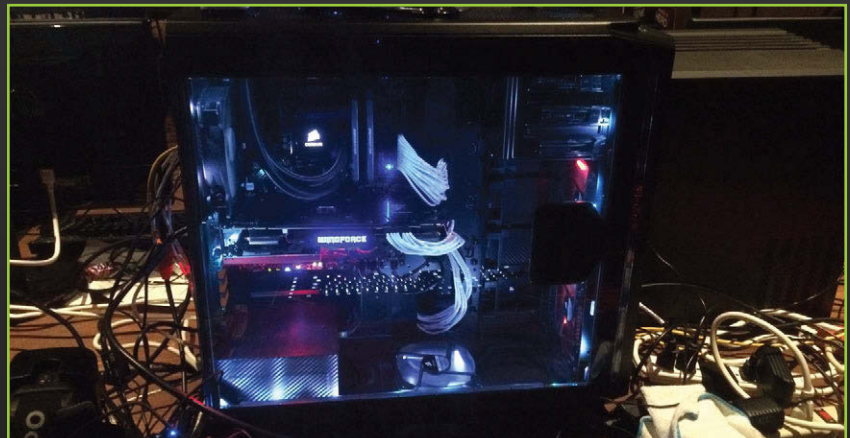
Speaking of contests, CPU sponsored the event's case mod contest, as we are often wont to do. Hats off to the mini-BASH attendees, who stepped up with the highest number of contest entries that we've had yet at a mini-BASH event! Our winner was Jarrod Tindall, whose MSI-themed mod sports MSI badging, a dragon window etching on the left side panel, and a tiny red dragon attached to his Toughpower XT power supply so that it looks as though it's "swimming" through the PSU.

Intel LANFest Atlanta Summer 2015

May 22 found us in the ATL for the summer installment of LANFest Atlanta. The 160-seat LAN took place at the Sheraton Atlanta Hotel, starting at 1 p.m. and running through 4 p.m. on Sunday, May 24. The main tournaments were for Counter-Strike: Global Offensive, which started at 7 p.m. Friday night, and League of Legends, which kicked off Saturday morning at 10 a.m. Proceeds went to the Gamers Outreach Foundation, which provides game kiosks (called “GO Karts”) to hospitals to brighten the day of kids and other long-term patients.



Our Intel LANFest-CPU Case Mod Contest was won by George Atchison, whose Corsair Graphite Series 760T is mostly stock on the outside, but has a super-clean interior with individually sleeved cables, just the right amount of lights, and a little carbon fiber DI-NOC here and there.



Intel LANFest Northwest Summer 2015

LANFest Northwest is a popular event in Hillsboro, Ore., in the Portland metro. It's a 144-seat BYOC event that we attended on June 19 (starting at 6 p.m.) through June 21 at 3 p.m. Intel hosted the LAN at its Ronler Acres (RA3) campus and held tournaments and contests for Team Fortress 2, Minecraft, League of Legends, PlanetSide 2, Primal Carnage, Left 4 Dead 2, and more.



As you might expect from a LAN party in the Portland area, LANFest Northwest's mod contest brought some very impressive PCs to bear, including systems from previous Mad Reader Mod winner Heath Coop, Matt "PDXLAN" Conwell, and several others. The coolest rig at the event, though, was Jessica Conwell's CaseLabs-based system with a GeForce GTX TITAN X peeking out of one side and a very chill panda gazing out from the other.

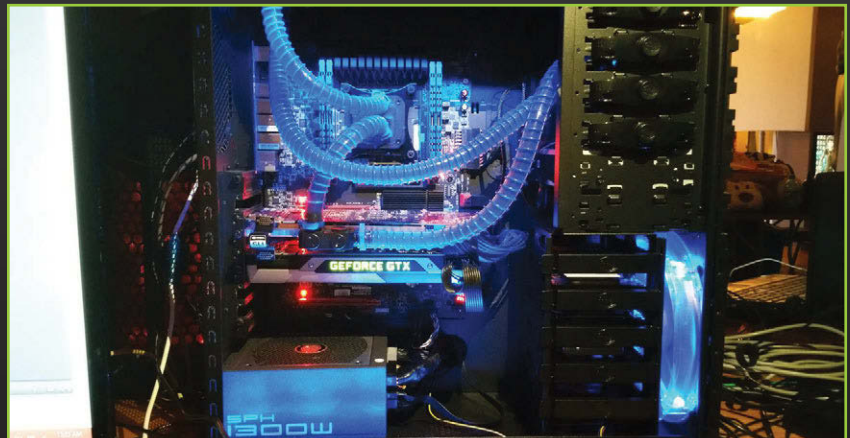


Intel LANFest MLP'015 Summer

On Friday, July 10 (starting at 9 a.m. and running through 4 p.m. Sunday, July 12), CPU attended LANFest MLP'015, aka MassiveLAN, in Hamburg, N.Y. The MassiveLAN crew holds their events at the Erie County Fairgrounds and puts on a great event every time. LANFest MLP is one of those great LANs where the tournaments and network gaming are just the beginning of the fun; this year's summer event also included some console gaming contest, Magic: the Gathering (the old-school analog variety), a chair race, a blindfolded keyboard assembly contest, and more.



The victor in MLP'015 Summer event's case mod contest was Jeff Zygaj, whose Cooler Master HAF-based rig's bright blue interior (complete with SLI, custom cooling loop, and custom power cables) was pretty tough to beat.



HARD HAT AREA
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The Riddler

Batman is obviously a very cool superhero; even if you personally don't care for Bats, you can't argue with his status as a comic-book icon. He is objectively and demonstrably awesome. Like all good fictional heroes, however, the Dark Knight owes a lot of his greatness to his nemeses—the villains he pits his will and strength and wits against in the never-ending struggle between good and evil. One of those villains, a character named Edward Nygma, aka the Riddler, was the inspiration for this month's Mad Reader Mod.

"Riddler is a criminal mastermind with a genius-level intellect, and I've always loved puzzles and riddles," says Jacky "_TechPuppet_" Mallet Higley. "I feel like he doesn't get the attention he deserves (especially compared to the Joker), as he's Batman's most intelligent adversary. Another reason I chose to go with the Riddler is that he is shown to be exceptionally skilled with engineering and technology, both of which interest me. I will be using this as my main computer, mostly for Photoshop, browsing, and some gaming."

Higley says her husband Shane "ericlee30" Higley helped out with the build and inspired her to get started in the first place.

"He has been modding and building computers for around 16 years now and has taught me everything I know about computers. When he showed me what I could really do with modding, and that I could create pretty much anything I wanted, the artist in me took over and I fell in love with computers and modding them," she says.

Riddle Me This

Higley says she began work on The Riddler on May 8, 2014, and that it was complete on April 20, 2015. She worked in a

dedicated work space in her office, where she says she does all of her modding and building.

"I used all purple anodized screws, nuts, and washers to give more color to the build," Higley says. "I bought most of them from Pro-Bolt, but there was a catch: Pro-Bolt didn't have all of the screws I needed, so I spoke with a friend who said he would anodize any screws I needed to finish the build. For decals, I used green and purple vinyl and cut them out using Silhouette's CAMEO electronic cutter."

Higley took her NZXT case to a local airbrush artist (Sonny Naylor of Naylor Finishes) to have the mural of Riddler and Gotham applied to it, but aside from that she performed all the mods on her own. She sleeved her 750-watt Seasonic power supply's cables in green and purple PET sleeving but ended up re-sleeving some of them a couple times to get the mix of purple and green just right. She mounted her cooling loop's EK reservoir horizontally between the PSU shroud and her graphics card and put the pump inside the case's internal drive cage with an EK bracket and some spot-on drilling.

Last but not least, Higley decided she wanted to go with rigid tubing, so she bought some PETG tubing and a heat gun and taught herself how to bend tubes.

"Once I got the hang of it, I started doing different kinds of bends, bending them all freehand," Higley says. "I wanted the bends to be complex with crazy angles to mimic the Riddler's personality. I will admit that it was no easy feat, and took a lot of my time—and more of my patience. But in the end, it was well worth all the energy I put into it, and I was pleased with the final result. To me, every detail counts and can really transform a build."



Riddle Me That

The Riddler consists of an Intel Core i7-3770K (overclocked to 4.7GHz), an MSI Z77 MPOWER board, 16B of Corsair Vengeance LP DDR3-1600 memory, an XFX Double Dissipation 7950 Black Edition graphics card (overclocked to 1,200MHz clock, 1,700MHz memory), a Seasonic X-Series 750W PSU, a 256GB Samsung 850 PRO boot SSD, a 750GB WD Black data drive, and an NZXT H440.

There's also Higley's custom cooling loop, which consists eight Alpenföhn Wing Boost 2 Plus fans, an EK Supremacy EVO Nickel Clean CSQ CPU block, an EK-7950 Acetal+Nickel GPU block, an EK-X3 250 reservoir, an EK-DDC 3.2 PWM pump, two EK CoolStream PE rads, PrimoChill PETG tubing, Bitspower matte black and PrimoChill purple fittings, and Mayhems coolant and dyes.

Higley says that although she's build a few systems in the past, The Riddler is her first liquid-cooled rig.

"When I got the case back after the mural was done, I leak-tested the system with distilled water, using an external PSU," she says. "Once everything was fine and dry, I added the coolant to the system, and the build was complete."

You Won Mad Reader Mod, But Why Stop At That?

Higley is already planning her next build, which she says will be specifically for high-end gaming.

"At this point, I have multiple ideas and themes I would like to go with, and I am trying to decide which one I would like to do next," she says. "While brainstorming and seeing which parts I want for my next build, I am also working on completing on two other builds. My six-year-old daughter's build, "Red Kaïda," is a fully black H440 build that will have red and chrome accents throughout the system, including red anodized screws and vinyl,

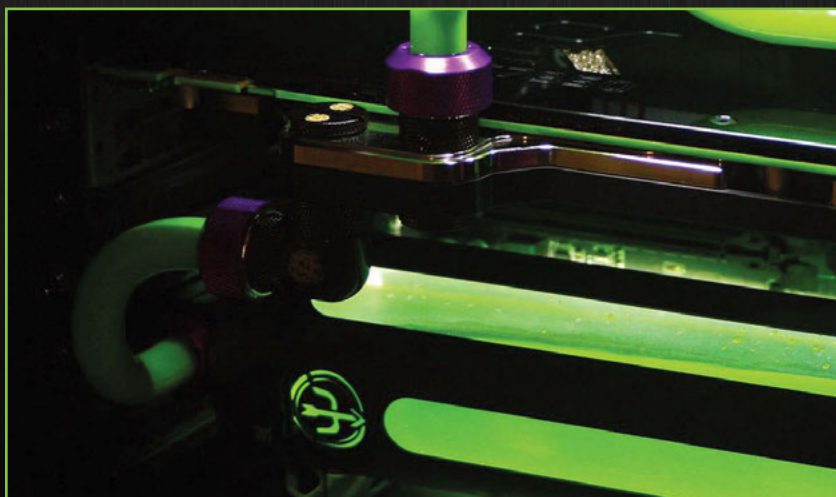
and is based on the MSI dragon. My husband Shane's build, "Midas," is a sleek black and gold build, for which we will be gold-plating some of the components, as well." ■

We Want Your Mod

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Six Men Enter, One Man Leaves

The 2015 Modders-Inc Staff vs. Staff Mod-Off



Vic McGuire's Captain America mod won first place in last year's Staff vs. Staff Mod-Off, and it's easy to see why.



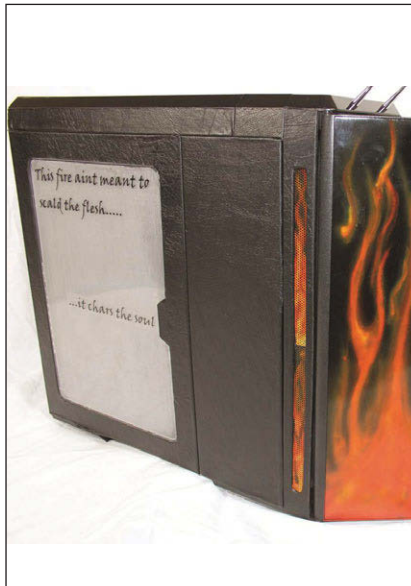
Al Shuryan came in second last year with this ominous and delightfully spiky Punisher mod.



Modders-Inc bossman Dewayne Carel came in third in 2014 with his Thor-themed mod, complete with LED lightning effects for Mjolnir.

July means it's time for QuakeCon. For the last several years, this has also meant that it's time for staff members from Modders-Inc.com to wage all-out modding war against one another, then box up their work and take it to the event in Dallas. This year will be no exception, and as usual, the guys agreed on a spending limit of \$250 for their projects. (See the "2015 Staff vs. Staff Mod-Off Official Rules" sidebar for the rest of the contest's requirements.)

"I know some people spend that much on paint alone, but you see, that's the whole idea," says Modders-Inc. head honcho and expert modder Dewayne Carel. "Putting limits on the contest means that you have to be more creative and less dollar-centered. Anyone can throw money at something to make it



Craig Tate's Ghost Rider mod came in fourth last year, despite having a built-in fog machine.

look cool, but to have to figure it out to get the same outcome is the exciting and challenging part of this contest."

This year the contest includes a couple veterans (Carel and Craig Tate) along with some new faces. Joe Mercado and Nick Blackwell are new to the Modders-Inc staff but are seasoned modders, while staffers Ron Perillo and Alex Lusakhpuryan will be attempting their very first mods.

Last year the guys all built mods with a superhero theme, resulting in excellent mods based on Thor, The Punisher, Ghost Rider, and Captain America (the contest winner). This year, the contest's themes are the universes of Quake and/or DOOM. As the guys set out on their modding journey, they each took a minute or two to share a few words with us about their approach to the contest.

Alex Lusakhpuryan

For me, it was hard to choose the right theme as I loved both series growing up. I really wanted to tackle both themes at the same time, but I felt that Quake mods are often all over the BYOC and we really don't see enough DOOM mods. So I've decided to go with a full DOOM theme for the project.

Everything starts with an idea, and that is usually the hardest part. To come up with a unique idea, you need creativity and imagination, and for this particular challenge I was ready to give my best. One of the features of DOOM that haunts die-hard gamers is "Skin Face." Skin Face is a texture that was created by Adrian Carmack (one of the four founders of id Software). This particular texture has swirling skulls that are coming out from the surface. I wanted to capture and interpret that in my mod. My vision was to create an illusion of skulls that would appear to be coming out from the case.

The scope of the project was not only to create a DOOM mod but also to educate beginner modders on techniques and methods for modding a case and to demonstrate how to overcome challenges created by having a set budget. I had to plan my materials carefully, and although most of us have a variety of tools at our disposal, I wanted to use only tools that can be found around the house or be picked up relatively cheaply at your local hardware store.

Joe Mercado

I remember my first QuakeCon in 2012 like it was yesterday. I had been following Modders-Inc for years, ever since I was 16, and laid my eyes on Craig Tate's Boss FX-57 mod. I knew that QuakeCon hosted a modding contest, but when I found out it would be Modders-Inc hosting it, I was ecstatic! It was the opportunity to meet the modders I had been following for years and who inspired me to begin modding. It was then I began work on Silhouette, my first-ever scratch build for Modders-Inc's QuakeCon modding competition. I remember walking into the BYOC and seeing all the mods and aisle after



Here's a look at some of Nick Blackwell's past work. Although he wasn't a competitor in last year's Mod-Off, but his Thanos theme would have made some sense among a field of Marvel comic characters.

aisle of custom rigs; I knew then that QuakeCon would be a yearly ritual for me. Fast-forward three years, and I now have the privilege of working side-by-side with my mentors—and showing them the youngster can take the crown.

This will be my first year in the Staff vs. Staff contest, but this is far from my first plunge into modding. My claim to fame is sleeving, however this time around I want to focus on two areas that have been somewhat lacking in my past projects: painting and

lighting. Yes, my goal with this mod is to compete with my modding brethren, but I also want to expand my skill sets.

This year the theme is Quake and/or DOOM, and after last year's hush-hush preview of the new DOOM, you better believe that my mod's theme shot over to the DOOM universe. Taking inspiration from some past projects of Blue Horse Studios' Ron Lee Christianson (specifically his "Half Life Black Mesa" and "Aliens" mods), I have decided to

dive into the world of polystyrene to build a UAC structure in the X1 chassis. The great thing about the X1 is that it already has that industrial cold-metal look to it that is prevalent in the Quake and DOOM universes. I also have some tricks up my sleeve that I want to save for the final debut of the mod.

Nick Blackwell

I have always loved the DOOM and Quake series of games by id Software. I used to play them a lot at my buddies' place on the LAN they had set up in their second living room. We used to be in there for

hours at a time—sometimes for days during the summers. So when I found out that the Modders-Inc Staff vs. Staff competition this year was going to be based on DOOM and Quake, I got super excited.

The name of my theme is "Ultra Violence." It is fourth of the DOOM games' five difficulty settings—and it's the furthest I ever went and still was able to complete the game. (Nightmare was exactly that: a nightmare.) I am going to be combining several effects to make the mod look very old and battle-worn, as if it had been left there by some poor, unsuspecting fool.

Materials will include a bit of acrylic, some hosing, and a bottle of hydrogen peroxide (!). The whole point of the mod is to make it look as good as possible while spending as little as possible using mainly household items. That way people can see you can still get awesome results and have a killer-looking PC without spending a whole lot of cash on fancy paint and laser cutting or CNC milling.

Ron Perillo

I cannot stress enough how important the first Quake game was in my life. Unlike the other guys at Modders-Inc, who have been around computers their entire lives, I did not own a PC until the fall of 1996. During that year, id released Quake, and it was the single-most mind-blowing thing I have ever seen after a friend installed the shareware version on my system. It was also the first PC game I have ever purchased after saving up my allowance for a few weeks, and ever since then I am a PC gamer for life. Outside of a Sega Dreamcast in 1999, I have neither sought out nor even been remotely interested in any console systems.

Also unlike the rest of the staff, I have not modded anything in my entire life except maybe installing a fan or two. Even the other guys who are not experienced case modders have experience in painting and are handy with their tools. Add the two new staff members (who are not just veteran modders but are actual QuakeCon case-modding champions) and the two elders (who have been modding since before I owned a PC), and you have an idea why I am not taking this mod-off lightly.

This nightmarish scenario is reminiscent of what I felt going through the levels of the original Quake game. I am outgunned and outnumbered in a place I cannot even begin to make sense of, and there are creatures both old and new after me that are armed to the teeth. There is also the \$250 limit, made worse by the fact that as a Canadian, I have to



Another of Dewayne Carel's past projects, this military monster was built to showcase ASUS' TUF Series motherboards. (Mission accomplished.)

contend with higher prices up here and a 13% sales tax on top of that. Oh, and I only have a month and a half left while having to maintain my regular content output for Modders-Inc.com and holding down a full-time day job. Needless to say, I am more stressed out than a 2GHz dual-core system running DOOM 3. But my dedication to Quake is a religious one, so I pray that Shub-Niggurath guides my way and hopefully provides a creative shortcut to get this project done.

Craig Tate

The D.E.A.D. (Doomified Engineered Attenuation Device) was used by a long-lost scientist at the murderous beginning of what we all thought would be the end. The device was designed to measure the horrible powers flowing through inter-dimensional rifts; it was thought that close analysis of these spectral energies would reveal countermeasures that the scientific community could use to assist our Marines and save so many lives. But just as the lives of the maniacal scientists who brought this curse upon us were cut short, so too was the life of one noble scientist who tried to stop it.

So new was the device and untested its tools that after its owner's death, it was found and removed from its protective stasis field in the most delicate fashion possible so as not to inadvertently activate it. One of the few UAC relics to survive the destruction of the Hell Breach, it had somehow survived the encroaching infection that we called "Doomflesh." Its power sources exposed and damaged by what appear to have been attacks by the entities known as Imps, the box is in remarkable condition, even though it appears to have been hit by several fireballs. Flesh-merged rocket fragments point to a possible Revenant attack that may have contributed to the device's damaged state. Small-arms fire damage bears witness to what was most likely the final, frenzied minutes of heroism as the scientist and his military escort made their final, tragic stand.

Not sure what my fellow staff will be doing to represent their builds,

but I will guarantee that you will have never seen anything quite like what I have in mind! A broken, but surprisingly intact UAC relic that was hastily constructed to combat the demon incursion, it will appear as if it has barely survived a horrific, close-quarters battle. I am creating a look and feel of "Doomflesh," which is the fleshy, undulating, growing surface that is seen throughout the game. I am hoping to create this look by using a wood base with cotton balls on top, overlaid with fiberglass to give it a continuously lumpy appearance. Hopefully, I can get the case to tell a story—a story of heroism and tragic failure.

Dewayne Carel

As one of the veterans of the Mod-Off, I know what it's like to win and to lose, and as they say, losing sucks! But seriously, it is all about the fun of the contest for me, as during the year we are

all working on other mods, hardware reviews, and stuff for the site. This is the one time of the year that we can compete against each other, and that of course means that we trash-talk even more than we usually do.

What is surprising is that we work closely all year long until mod-off time and then it is all quiet about our staff vs. staff modding projects.

DOOM and Quake are our available themes for this year's contest, which seemed appropriate since it is the 20th anniversary of QuakeCon. I will be creating a DOOM case because I think this franchise has the most recognizable features that I can pull from it and put into a case mod. My two main features that I will be incorporating into the DOOM mod are the Icon of Sin final boss and a "ghost" monitor in one of the side panels. This ghost monitor will be playing a loop of the DOOM game, but you'll be able to see through it and into the inside of the case. ■

2015 Staff vs. Staff Mod-Off Official Rules

1. Each contestant starts with the same case: the Thermaltake Core X1.
2. Each contestant can spend only \$250 in creating his mod.
3. A theme was chosen to level the playing field: All mods must have a DOOM or Quake theme, or a combination of both.
4. All work on the mod must be done by the contestant, except as outlined in Rule No.5.
5. If you need to have something created that you cannot make yourself (graphics, 3D printing, media blasting, cutting metal, etc.), you must deduct these costs from your allotted \$250. No friend or barter pricing allowed! We want to represent the actual cost of creating the mods.
6. You can use whatever materials or hardware you have on hand, but you need to deduct such items' current value from your \$250. (Just because you have \$1,000 worth of custom billet aluminum or a \$300 motherboard lying around doesn't mean you can use them for free.)
7. You must keep a work log containing photos and/or videos in the Modders-Inc forums for your project to be eligible for the contest.
8. The case must be on display at QuakeCon 2015 to be part of the contest.

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Clock Work Like Clockwork

How To Overclock Your Hardware

Becoming a full-fledged power user is a lot like riding a bike. Nobody wakes up and starts doing double backflips at their local BMX track. You start small and you start slow. Training wheels come first, and sometimes you still lean on one for a while before ditching them altogether. Even after you think you've mastered your first "big kid's" bike, you're a long way from the X Games, punk.

Likewise, the vast majority of us didn't become power users overnight. The process happens in stages. Our training wheels were upgrading our first system's RAM, adding a second hard drive, or installing a DVD burner. Nothing exploded, so, confident in our abilities, we upped the difficulty and built our first custom PC from scratch. At this point, we started to feel legit, almost like we knew what we were doing.

Once you've built a PC, and built some confidence in the process, you should be ready to take on more challenging projects. That project could be a more advanced build (one that involves a custom liquid cooling loop, perhaps), a basic case mod (such as a wild new paint job for your case), or overclocking your system's components. This last task is what we'll focus on this month, and it doesn't have to be scary.

Overclocking, or the process of increasing your hardware's operating frequencies beyond their stock values, is a relatively easy method to squeeze a little extra performance out of your system without buying newer, better components. In some situations, overclocking lets you take a "second-best" component in a particular product family

and increase its performance to be on par with that family's flagship unit, potentially giving you hundreds of dollars' worth of extra performance for free. Interested? You should be.

Speaking of the X Games, just like there are only a handful of Dave Mirra or Jamie Bestwick types in professional BMX, there are a select few hardcore overclockers who regularly compete against each other for world records, prizes, and glory. Now, you can join this group with enough determination, but first you have to master the fundamentals. We'll be covering those fundamentals here, giving you the information you need to begin some overclocking adventures of your own. To be clear, overclocking is an extensive subject worthy of multiple articles. Further, although it's obvious that different components overclock differently and that different models of the same type of component overclock differently, individual units of the same model often overclock differently, too, so it's vital to learn the basic principles first.

For this piece, we'll cover the basics of overclocking the following three components: CPU, GPU, and RAM. Follow along as we boost the frequencies of our hardware and reap the rewards.

The Overclocker's Toolkit

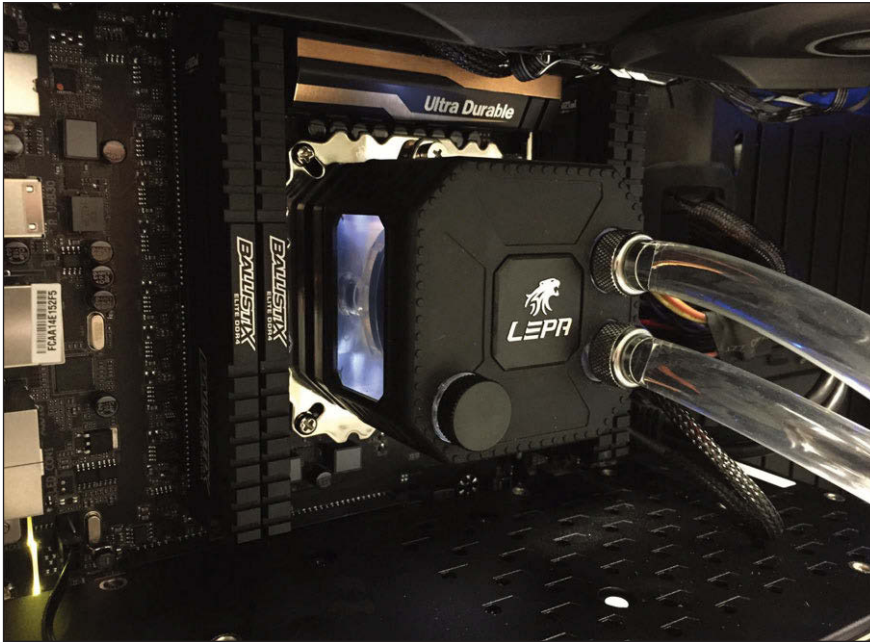
Technically, you can overclock any processor, graphics card, or memory module, but that doesn't mean you should. With



Technically, you can overclock any processor, but you'll have the most success by far selecting one with an unlocked multiplier, such as Intel's Core i7-5960X Extreme Edition.

CPUs, for example, Intel and AMD now produce processors with unlocked multipliers designed expressly for overclocking. As we've explained previously, an unlocked multiplier lets you isolate and increase the frequency of only the processor. Intel designates its unlocked processors with a "K" or "X" suffix, while AMD regularly uses "Black Edition," "FX," and "K" labels to identify the unlocked processors in its lineup.

The primary side effect of overclocking your processor is increased heat, so if you really want to be serious about overclocking your CPU, your



Overclocking means higher frequencies, and higher frequencies mean higher temperatures. Higher temperatures mean you'd better have a capable cooler attached to any component you plan to overclock. Pictured here is LEPA's burly EXIllusion 240.

first order of business is to acquire a good third-party cooler. Stock coolers included with CPUs may be able to handle the extra heat of an overclocked processor to a limited degree, but they're not really built for that purpose. Plus, over the last few years, both Intel and AMD have begun releasing their unlocked processors without stock cooling and simply letting individual users choose their own cooler. It's not a cost-cutting measure so much as an informal acknowledgement that those stock donut and brick heatsinks are destined for the dumpster the second an overclocker pulls one out of the box. We'll leave choosing a cooler for your processor up to you, but product reviews online or right here in *CPU* can help you make an informed decision.

We won't be installing an aftermarket cooler on our graphics card for this tutorial, but we can offer a few very general guidelines if you wish to replace your graphics card's stock cooler with something more substantial. The key consideration when outfitting your

graphics card with an aftermarket cooler is compatibility. NVIDIA's and AMD's board partners frequently make changes to reference-design GeForce and Radeon offerings, and that can include changes to the PCB. Double-check to make sure that the air cooler or waterblock you want to use is compatible with your graphics card. Also determine if an aftermarket air cooler will increase the card's physical footprint. For example, if you have two dual-slot graphics cards installed in SLI/CrossFire, removing the stock air cooling and adding a third-party option could turn that dual-slot card into a tri-slot card and encroach onto the second card's territory.

There's a general consensus among enthusiasts that fiddling with your memory modules' cooling doesn't have a substantial impact on their overclocking. The quality of the ICs used in your modules, which is out of your hands, affects performance perhaps more than any other factor.

Once you've established how you're going to handle the increased temperatures

that come with increased frequencies, you have to have a way to actually increase those frequencies. For the CPU and memory, your best bet is to dive into your motherboard's system BIOS. There are plenty of Windows-based overclocking utilities for the CPU, but we prefer to stick with the BIOS. Once you're ready to move beyond basic overclocking, you'll want to be well acquainted with your motherboard's BIOS, since this is where you'll have access to the most advanced settings.

Overclocking your graphics card, on the other hand, requires a Windows-based software utility. Here again, there are no shortage of utilities that will help you dial in higher frequencies for your graphics card's GPU and memory. You can use AMD's Catalyst Control Center to overclock cards based on AMD silicon, while NVIDIA-based cards typically rely on utilities that the company's partners develop. For example, we used MSI's AfterBurner software to overclock our MSI card. Similar offerings are available from GIGABYTE, ASUS, etc.

You'll need more software to make sure your system will remain stable for regular, long-term use. There are obvious red flags that a particular overclock is unstable—your system refuses to POST, Windows blue-screens during boot or simply won't boot at all, and so forth—but many times an overclocked system will boot Windows and nothing else. It's these deceptive overclocks that you need to root out.

For quick stability checks, a utility like Intel's XTU (Extreme Tuning Utility) can test an overclocked Intel processor for stability in a few minutes, which is great for determining if your CPU can run at its higher frequency, but most power users like to stress-test their CPUs for several hours to ensure long-term viability. For this, Intel XTU can be set to run for a user-defined period of time, or you can enlist the services of an application such as Prime95, which hammers the CPU and can be set up to run indefinitely.

Likewise, the GPU overclocking apps should be able to perform basic stress-

testing in order to give you a general idea of whether the higher frequencies will turn out to be stable, but you still need to give your overclocked graphics card a heavy, sustained workload to determine if the overclock will work. Having a program that you can loop is great because you won't have to babysit your system while it stress-tests the graphics card. One such program is Futuremark's 3DMark.

Full Speed Ahead

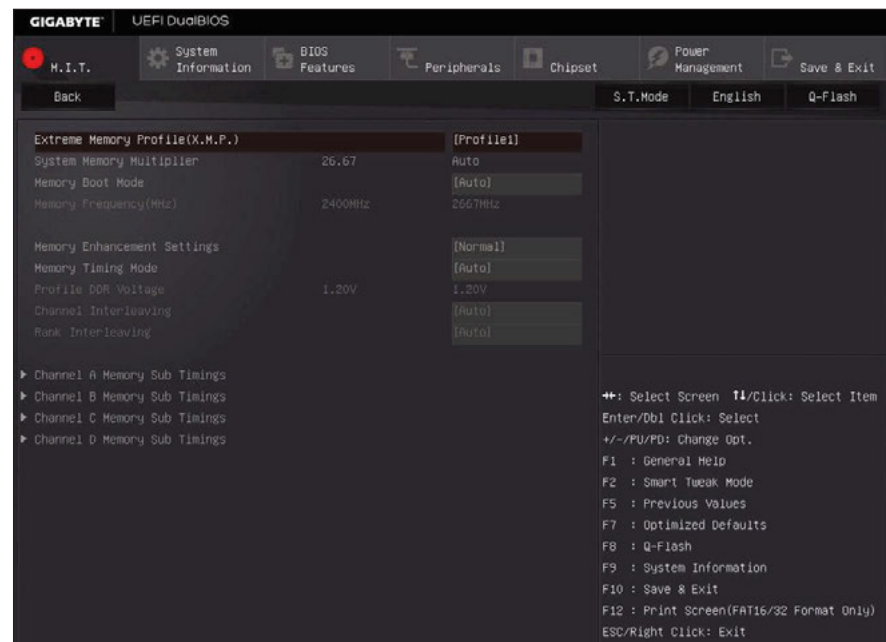
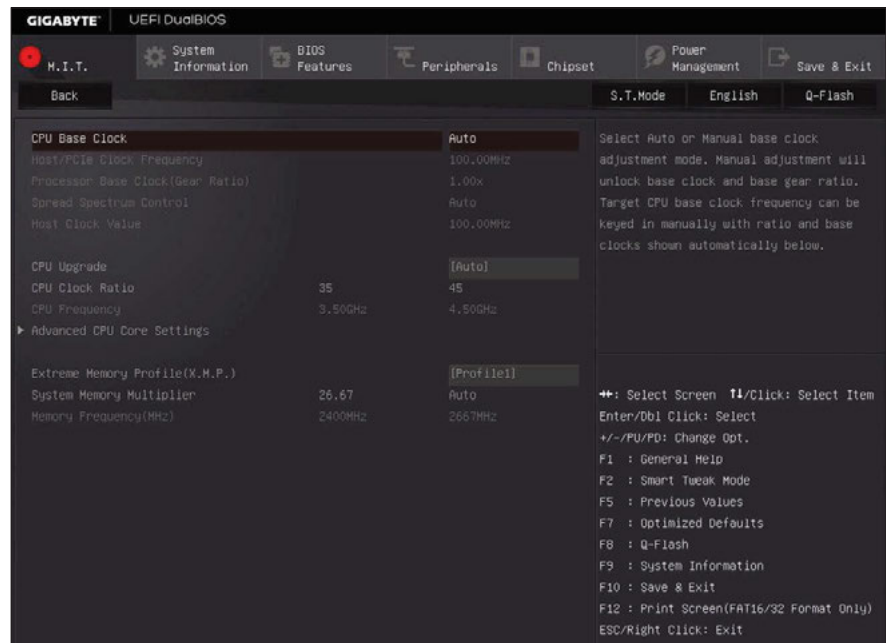
With the proper hardware and software in hand, you're ready to start turning the dials, so to speak. Our first stop will be the CPU, and as we've mentioned, you'll venture into your motherboard's BIOS to take care of business.

Every motherboard manufacturer structures its motherboard BIOSes differently, and some offer you more extensive control over your CPU's settings (particularly, its various voltages). Every enthusiast motherboard should give you basic control over your processor's multiplier and core voltage, which are the two settings we're after. Also, although BIOS menus and sub-menus are labeled differently from manufacturer to manufacturer, you can usually navigate your way by keeping an eye out for phrases such as "Advanced Frequency Settings," "CPU OC," etc. Sometimes you'll find the multiplier and voltage settings under the same submenu; other times you'll have to bounce from submenu to submenu.

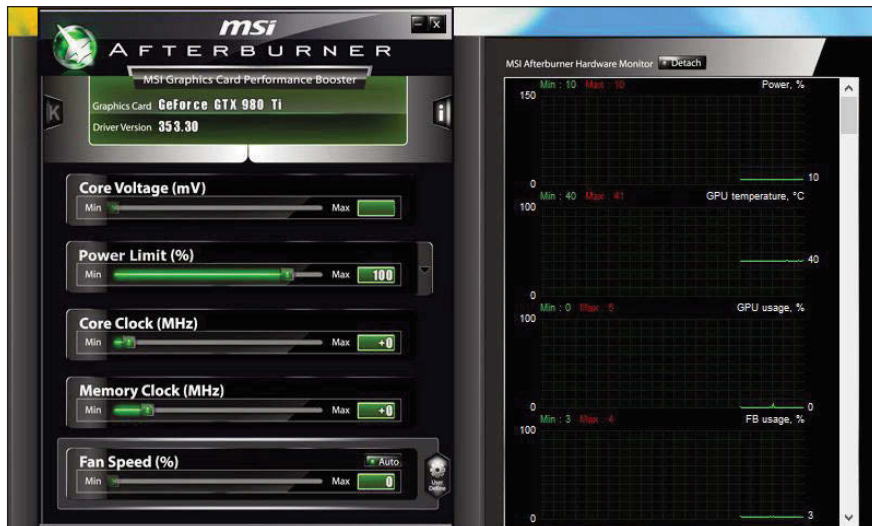
Start by increasing the multiplier, and thus, the frequency. Your goal should be to overclock your CPU as far as it will go without requiring additional voltage to maintain stability. The process is relatively simple, but it can also be tedious; the safest way to overclock is to go 100MHz at a time and then test for stability, repeating these two steps until the CPU fails a stress test, can't boot Windows, or doesn't POST. As a general rule of thumb, though, today's processors that are designed to be overclocked should be good enough to handle a 10%

overclock without any further tweaking. For example, when we overclocked our Intel Core i7-5930K for this month's CPU system build, we started at 3.8GHz, which is 300MHz (or 8.5%) faster than the 5930K's stock speed.

When you reach the upper boundary of the frequency at which your CPU remains stable under load, you'll need to feed it more volts in order to go faster. Although modern chips have built-in safeguards that should prevent any damage from frequency



Get used to seeing screens like these. Your motherboard's system BIOS is where you'll be tinkering with your CPU's clock speed and voltage settings. The introduction of preconfigured memory profiles, such as Intel's XMP (Extreme Memory Profile) has made overclocking DRAM a trivial affair.



Most graphics card manufacturers have downloadable utilities that not only let you overclock your graphics card(s) but also stress-test them for stability.

adjustments alone, increasing a processor's core voltage beyond its stock specifications is more dangerous. A cavalier approach here could result in permanent damage and send your silicon to the scrap heap in short order. Proceed carefully.

You may want to research your processor online before attempting to overvolt it. The overclocking community regularly shares its experiences and results online, so check a few forums to get a general idea of what core voltage will put your particular processor in the danger zone. However, because one batch of a particular CPU will overclock better than a different batch of the same CPU, you should view any consensus voltage setting as a point where you'll need to be extra cautious about proceeding, rather than a starting point for your own overvolting.

As a general rule of thumb, we will start by increasing our processor's Vcore by 0.1V. Next, you'll want to stress-test to determine both the stability of the overclocked frequency and the CPU's core temperature under load at a higher voltage. As long as your processor stays within the manufacturer's specified thermal parameters, continue increasing the processors frequency until it becomes unstable again. When that happens, return to your BIOS,

increase the voltage again, and run more stress tests.

After just one or two 0.1V increases, we will frequently take an even more conservative approach to supplying any additional voltage. We'll typically halve the increment to 0.05V. Eventually, you'll

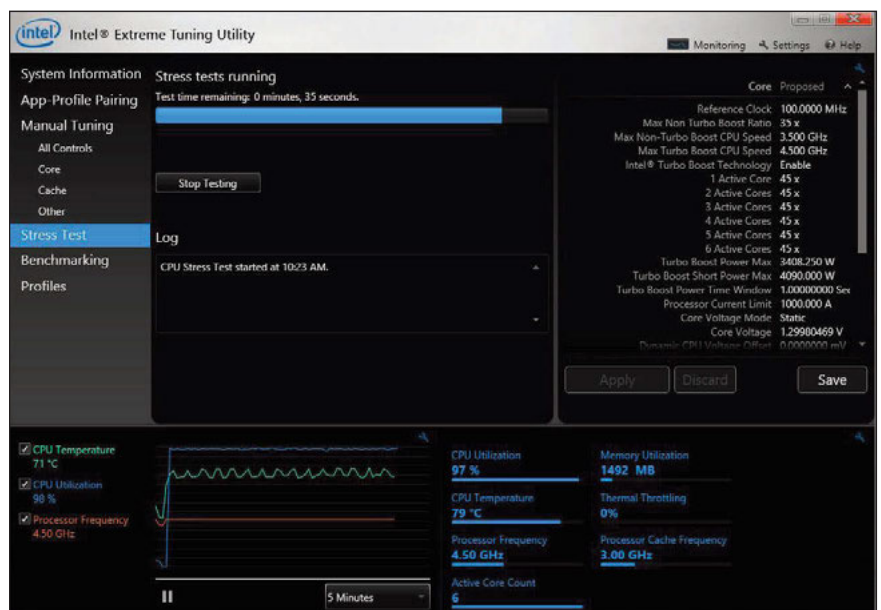
arrive at both the maximum frequency and voltage at which your CPU can safely operate. To be sure the overclock is legit, run your stress tests for several hours, and if your system crashes, you'll have to dial down the frequency until your system can run under load for extended periods without issue.

In theory, this is how CPU overclocking should work, but the process is far from an exact science. Often, a processor will hit a maximum frequency and won't budge any further, even if you increase the core voltage. You also have to accept that your version of Processor X may not overclock as well as your friend's Processor X. These are the realities of overclocking.

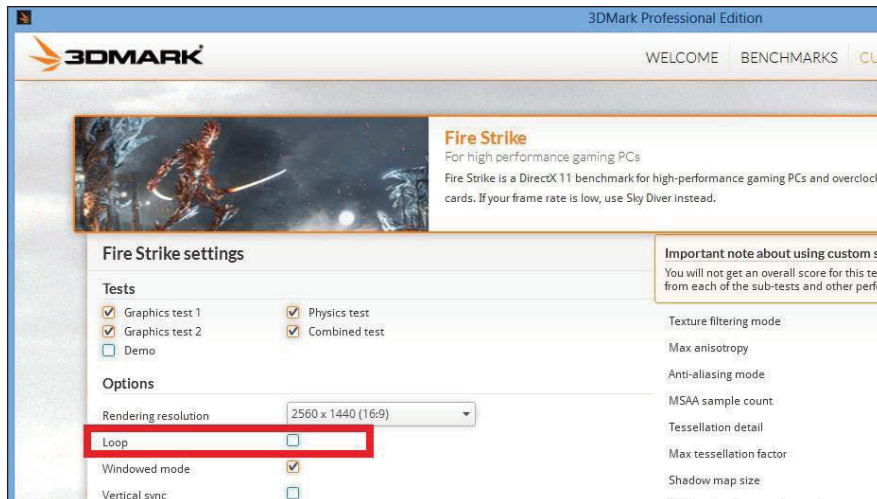
Minimize Memory Meddling

There was a time when overclocking memory modules was even more exhausting than overclocking the CPU. Memory modules have a clock speed, just like CPUs, but they also have several timings, which made overclocking DRAM a precarious juggling act.

Today, we have preconfigured memory modules, such as Intel's XMP (Extreme Memory Profile) to do that work for us. Understanding that many enthusiasts still



Intel's XTU (Extreme Tuning Utility) is a handy little program that lets you work with your Intel processor's overclock in a Windows environment. In addition to being able to stress-test the CPU, Intel's XTU displays a wealth of information about your processor's vitals.



A responsible overclocker is quick to develop good overclocking habits, one of which is letting your stress tests run for several hours (a full 24 hours should be thorough enough). Having a program you can loop, such as Futuremark's 3DMark, can untether you from your desk while it works out your overclocked hardware.

want to mess with a good thing, we spoke with Crucial Memory's Jeremy Mortenson to understand the finer points of modern DRAM optimization.

"Ultimately, the memory is designed to run at the rated specification, or XMP Profile 1, in supported systems," he says, "and users will get the easiest setup with guaranteed results. XMP takes the guesswork out of memory tuning and saves you from having to dig in and learn about the all the various adjustments and terminology associated with memory."

A common debate among power users is the relationship between memory speed and latency. Usually, to increase your modules' speed, you loosen their timings, which increases latency and can potentially erase any performance gains from increasing the speed. If you have to decide between one or the other, Mortenson believes—based on Crucial's extensive testing (see bit.ly/1JyzzH)—increasing memory frequencies usually yields better performance than lowering timings.

Overvolting memory won't give you the same results you might expect from overvolting the CPU. New JEDEC DDR specifications call for lower operating voltage (DDR2's was 1.8V, DDR3's was 1.5V, and DDR4's is a mere 1.2V), but don't think that means new modules suddenly have a tremendous amount of

headroom. Says Mortenson, "The 1.2V specification doesn't necessarily imply that it will overclock better. DRAM is built on an industry standard where voltages are defined for the memory, processor, and subsystems. Some parts perform 'better' with more voltage applied, but there are cases where the benefit of additional voltage doesn't pay back in terms of higher frequencies. It will likely create a reliability risk, or worse, potentially damage your parts. It's best to stay within your manufacturer's recommended voltage range."

Although preset memory profiles take the adventure out of overclocking, they're there for good reason. Some motherboards automatically set your modules to run at their optimal profile, but you can set it yourself in your motherboard's BIOS. These settings should be somewhere under your BIOS' performance or overclocking menu. Look for an option that refers to advanced memory settings; you should be able to lock in your kit's memory profile here.

GPU Unleashed

The last stop on our journey is the graphics card, another component that often has quite a bit of overclocking potential if you're willing to put in the time to extract it. Usually the best return on investment

for GPU overclocking is to buy a card that's a step down from a manufacturer's flagship model, overclock it to approach a performance level on par with or better than the flagship, and then pocket the savings.

Finding the right balance between a GPU's core clock and the right amount of voltage is still a delicate process, but you do have the benefit of being able to do all the work within Windows. Plus, as we mentioned, GPU overclocking utilities should be able to both pump up a card's clocks and then test those clocks for stability. Hit up your graphics card manufacturer's website to download the relevant utility.

If your card's manufacturer doesn't publish an overclocking tool, don't panic. You may be able to use a rival company's overclocking tool. MSI's Afterburner is one such example that should be compatible with a variety of graphics cards.

Launch your graphics card's overclocking utility and proceed in a similar fashion as you would with the CPU, increasing the core clock gradually and testing for stability. If your graphics card tuning app has a fan speed setting, it might not be a bad idea to force the card's fans to run at 100% to ensure maximum cooling. When you hit an unstable frequency carefully raise the voltage and test again. When the card passes the utility's built-in stability test, you're ready to stress-test it further with an intense 3D rendering benchmark, such as 3DMark, or simply fire up your favorite game and take it for a spin.

An unstable graphics card can identify itself by crashing whatever program happens to be taxing it, but it can also show up in more subtle ways. If you notice on-screen artifacts, it's a sure sign your GPU's clocks need to be dialed back.

Life In The Fast Lane

Some power users overclock to get extra performance for free. Some do it for bragging rights. Others do it simply because they can, and because tinkering is fun. Whatever the reason, we encourage you to give it a shot. It might be the last time you settle for stock. ■



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SAPPHIRE Tri-X R9 Fury OC

The Revolution Starts Now

It has been a while since there was a truly new graphics cards technology for us to put under the microscope. Sure, AMD and NVIDIA have been updating their respective lineups for the last several years, but when faced with a fourth straight year of manufacturing graphics processors at the 28nm node (and with the 14nm process not expected until 2016 at the earliest), the best and most reliable way to improve performance has been simply to cram more transistors onto the die and increase the stream processor/CUDA core count.

As graphics card TDPs climb higher, however, cards are beginning to reach the limits of the PCIe bus standard, which is 300 watts for PCIe 3.0. More powerful cards exist, but they don't have the PCI-SIG's (PCI Special Interest Group) seal of approval. But now that 4K displays have finally begun to take hold with users, the memory subsystems on even the fastest cards that money can buy have begun to show their limitations.

There is a solution to the problem. With the launch of AMD's Fiji chip, the memory subsystem is getting a much-needed overhaul, and we finally get to talk about a few things we've never seen before (and will be seeing a lot more of from here on in). Last month, AMD took the wraps off the R9 Fury X, the firm's latest flagship graphics card with a built-in closed-loop liquid cooler. This month, the more affordable Fiji Pro is getting its moment in the spotlight, and our first look at the chip comes in the form of SAPPHIRE's Tri-X R9 Fury OC. Before we delve into what makes the SAPPHIRE card such a winner, let's take a closer look at how AMD was able to make such a big splash while relying on an effectively ancient manufacturing node.

HBM FTW

It's called High Bandwidth Memory, or HBM for short, and it presents a number



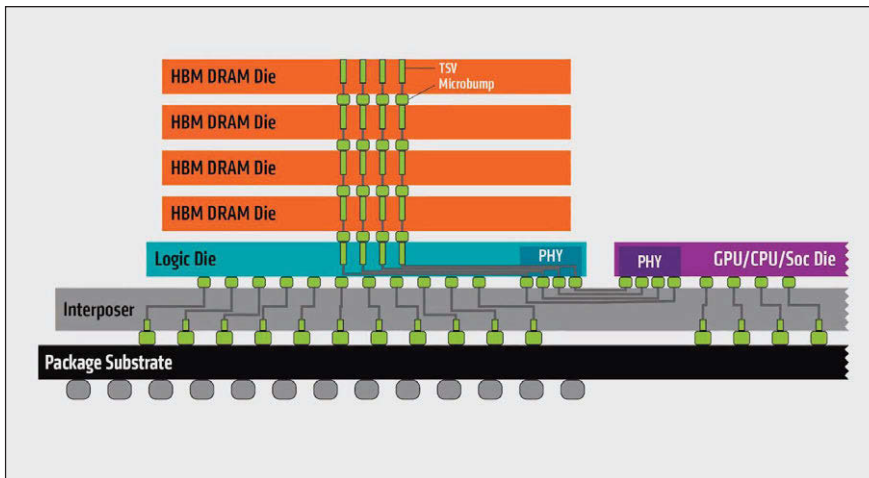
SAPPHIRE's Tri-X R9 Fury OC features the firm's most efficient cooler ever.

of benefits to the Fiji GPU. On a traditional high-performance graphics card, usually a dozen or more GDDR5 chips are arrayed around the GPU. Each of these features dozens of contacts (170-ball BGA package is common for current GDDR5 chips) that require traces leading back to the GPU. The more memory a card needs, the more chips are required, which leads to longer traces and ultimately more voltage and beefier voltage regulating components to power it all. As the GPU arms races continues, cramming everything necessary onto a PCB that'll fit in your average midtower becomes increasingly difficult. To use an example from AMD's previous generation, the flagship Radeon R9 290X had a memory and GPU footprint of 90mm x 110mm, not counting the VRM.

HBM is a memory standard that replaces the traditional GDDR5 memory

used in current graphics cards. It supports high densities by stacking the DRAM cores on top of one another. In the Fiji GPU, AMD layered four DRAM chips in four stacks. An electrical interface passes through holes in each of the DRAM chips and connects them all to a base layer. As you can imagine, this TSV (through-silicon via) micro-bump design can enable component manufacturers to implement large caches of memory in very small spaces on a PCB, but AMD took it a step further and added the HBM onto the GPU's substrate. Because the 3D stacking technique AMD uses doesn't pile the memory over to GPU die itself, the firm refers to its design as 2.5D, rather than 3D, despite the fact that the chip features layers along the X, Y, and Z axes.

There are numerous advantages to keeping your DRAM close to your



A single GDDR5 chip has a 32-bit bus and can run at speeds up to 1,750MHz, good for a maximum memory bandwidth of 28GBps. In Fiji's HBM, each stack supports a clock speed of only 500MHz, but with an extremely wide 1,024-bit bus, a single stack can produce a whopping 128GBps of bandwidth. For the Tri-X R9 Fury OC, its four stacks of HBM result in a 4,096-bit bus and 512GBps of total memory bandwidth.

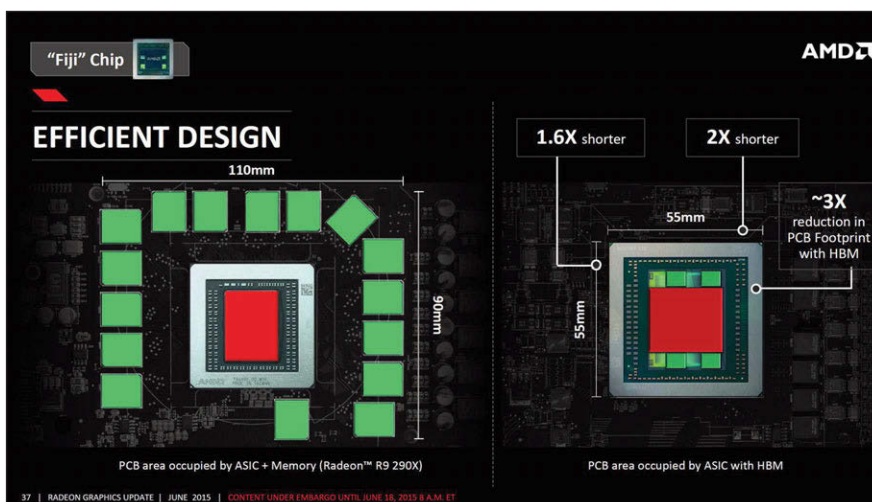
The Next GCN

Before AMD launched its recent R9 300 series, the flagship spot was held by the Radeon R9 290X, a card whose GPU architecture was technically not the company's most recent. The Radeon R9 285, a midrange graphics card that came out in September 2014 and currently sells for around \$230, actually used the most recent version of AMD's GCN architecture (version 1.2). It brought with it a handful of new things, such as improved geometry processors that are better tuned to handle tessellation, delta color compression for lossless color rendering without consuming too much memory bandwidth during reads and writes, an updated ISA instruction set, a high quality scaler, and a new multi-media engine.

Fiji includes all of the improvements that went into the R9 285, as well as a few new ones, including new 16-bit floating-point and integer instructions, improved parallel processing instructions that let SIMD lanes share data, better compute task scheduling, a larger 2MB L2 cache, an even better scaler, and a new video decode engine that now supports HEVC (High Efficiency Video Coding), which is a video compression standard designed to succeed the H.264/MPEG-4 AVC standard.

Fury X's Big Little Brother

The SAPPHIRE Tri-X R9 Fury OC features the same GPU as that of the Fury X, albeit with eight of the flagship GPU's CUs (compute units) disabled, giving it a stream processor count of 3,584 and a texture unit count of



By stacking memory chips, High Bandwidth Memory shortens traces, reduces voltages, and significantly widens the memory bus, dramatically reducing the graphics card's PCB real estate requirements.

GPU, but AMD had to design a unique interposer that resides between the package substrate (the part of the chip that features the interface, such as a ball grid array) and the GPU die to support its HBM design in Fiji. The logic die that serves as the foundation for each stack of HBM connects directly to this interposer and is effectively on the same plane as the GPU die. The result is a very small package that measures 55mm x 55mm that can support incredibly wide buses. Bandwidth per watt improves by a factor of four, communication and clocking are streamlined, and compared to the R9 290X, Fiji-based graphics cards have 60% higher memory bandwidth.

Another advantage that AMD enjoys thanks to its HBM design is a reduced cooling footprint. The coolers on the liquid-cooled Fury X and the air-cooled Tri-X R9 Fury OC can efficiently cool both the GPU and memory at once using a small copper plate and another smaller copper plate with thermal pads for the VRM. Traditional graphics cards require almost twice as much copper to cover the DRAM, which adds considerable cost. The required voltage for Fiji's HBM is 1.3V, compared to GDDR5's 1.5V, further slashing the new cards' cooling requirements.

When you break down the per-package performance of GDDR5 and HBM, you'll realize there's really no contest.

224. There are 64 ROPs, which is the same number as the full Fury X. The core clock of the SAPPHIRE card we tested is set at 1,040MHz, which is a factory overclock.

Because the HBM is integrated with the GPU now, you won't see any variants of the Fury with less (or more) than 4GB of VRAM. Although that doesn't sound like a 4K-capable frame buffer, the speed of the memory and the memory bus make it much more akin to CPU cache than a traditional GDDR5 frame buffer. As we mentioned, the memory interface is 4,096 bits wide, and the card features a 512GBps of total memory bandwidth. Compare that to the R9 290X's 320GBps of total memory bandwidth and you can begin to see how big an impact HBM can make on your gaming experience.

Another feature that this card supports, although it's one that AMD has supported for a while, is CrossFire connections without the use of a bridge connector.

Like It? Win It

If you like what we've shown you with the SAPPHIRE Tri-X R9 Fury OC, you can actually enter for a chance to win one of these impressive cards. Just visit <http://sapphireation.net/theclock> for rules, information, and limitations.

AMD's PCB & SAPPHIRE's Tri-X Cooler

SAPPHIRE tells us that the matte black PCB used in its Tri-X R9 Fury OC is a reference design, so there's not much here that'll be unique compared to other reference design Fury cards that you can buy. But that's not to say there isn't anything interesting. We particularly like the strip of nine LEDs above the pair of 8-pin PCIe power connectors. You can tweak the colors (red, blue, or both) using the DIP switches on the card, and they light up in greater number as the graphics workload increases. The first LED is

always lit, and it indicates that AMD ZeroPower Mode is active; this disables the fans under idle and light loads to keep the card as quiet as possible. The other obvious thing to note about the PCB is its size, it measures a mere 7.5 inches long.

There's also an inconspicuous dual BIOS switch on the top edge of the card. In the default position, the ASIC power is limited to 300 watts and the GPU temperature is maintained at a peak of 75 degrees Celsius. We pushed the Tri-X R9 Fury OC to its limits by running Dying Light and an instance of Unigine Heaven 4.0 simultaneously, and the temp hovered between 74C and 75C, with the fans never spinning above 29%. Needless to say, it was very quiet. If you're looking to overclock the Tri-X R9 Fury, you may have more luck with the secondary BIOS settings, which give the ASIC 350-watts to work with and relax the temperature limit to 80C.

Despite the reference PCB, the cooler is all SAPPHIRE's. It features



Despite the revolutionary technology underneath the cooler, SAPPHIRE's Tri-X R9 Fury looks similar to previous Tri-X cards.

a trio of 90mm aerofoil-finned fans that have long-lasting dual-ball bearing hubs. There are some truly mammoth copper heatpipes in this cooler—one measuring 10mm in diameter, two more at 8mm, and the rest are 6mm. They run through a dense stack of cooler fins and meet over two copper plates, one for the GPU and HBM, the other for the VRM. It's 12 inches long and, according to the firm, designed to deliver sub-75C performance even under the stress of demanding 3D applications and games. As we showed above, this is indeed the case. Put simply, this is SAPPHIRE's most efficient Tri-X cooler ever.

Adding to the rigidity of this card are the die-cast mounting frame for the PCB and cooler assembly, as well as a brushed black aluminum backplate adorned with yellow and grey stripes. SAPPHIRE's Intelligent Fan Control (IFC-II) technology is here, too, though it provides the same function as AMD's ZeroPower Mode, stopping the fans from spinning while idle or under light loads. Fan control is performed thanks to a network of built-in sensors.

SAPPHIRE has a relatively new grading system for indicating its graphics cards' performance, called the SAPPHIRE Performance Index. The Tri-X R9 Fury OC is an SPI 5 class card, or "ultra enthusiast level for 4K gaming."

On the back bracket, you'll find three DisplayPort 1.2 outputs and one HDMI 1.4a output, but no DVI. There's an active DP-to-DVI adapter included in the package, as well as an HDMI cable. The Tri-X R9 Fury OC supports four monitors natively, or up to six via MST hub or daisy chain. As we mentioned, this card features a pair of 8-pin PCIe power connectors, and SAPPHIRE recommends a 750W PSU or better. Of course, the card is DX12-ready, supports AMD FreeSync, AMD VSR (Virtual Super Resolution), and AMD LiquidVR.

Benchmark Breakdown

SAPPHIRE's Tri-X R9 Fury OC is aimed at 4K gaming scenarios, which

FURIOUS PERFORMANCE STRAIGHT OUT OF THE BOX

Benchmark Results	SAPPHIRE Tri-X R9 Fury OC	AMD R9 Fury
Price	\$569	\$549
Core clock	1,040MHz	1,000MHz
Memory clock	500MHz	500MHz
Memory interface	4,096-bit	4,096-bit
Memory	4GB HBM	4GB HBM
3DMark Fire Strike Ultra	3729	3615
Graphics Score	3680	3563
Physics Score	15899	15985
Graphics Test 1	18.33	17.73
Graphics Test 2	14.2	13.76
Combined Test	8.48	8.21
3DMark Fire Strike Extreme	6874	6631
Graphics Score	7228	6922
Physics Score	15415	15908
Graphics Test 1	35.43	33.96
Graphics Test 2	28.24	27.03
Combined Test	14.55	14.08
Unigine Heaven 4.0		
Score	1441	1373
FPS	57.2	54.5
Games	1,920 x 1,080	
Aliens VS. Predator (Very High, 16XAF, 4XAA, SSAO)	127.4	123.9
Metro: Last Light (DX11, Very High, 16XAF, Very High Tess.)	94.33	91
Dying Light (Medium, AO On, AA On, Vsync Off)	118.42	111.57
Witcher 3: Wild Hunt (Vsync Off, Unl. FPS, Ultra)	67.35	59.52
Games	2,560 x 1,440	
Aliens VS. Predator (Very High, 16XAF, 4XAA, SSAO)	82.5	80.3
Metro: Last Light (DX11, Very High, 16XAF, Very High Tess.)	64	62.33
Dying Light (Medium, AO On, AA On, Vsync Off)	85.25	78.49
Witcher 3: Wild Hunt (Vsync Off, Unl. FPS, Ultra)	54.41	53.97

Test system specs: Processor: Intel Core i7-5960X; Motherboard: GIGABYTE X99-Gaming G1; RAM: 16GB Ballistix Elite DDR4-2400; Storage: 240GB OCZ Vertex 3 MAX IOPS SSD; OS: Windows 8 Enterprise (64-bit)

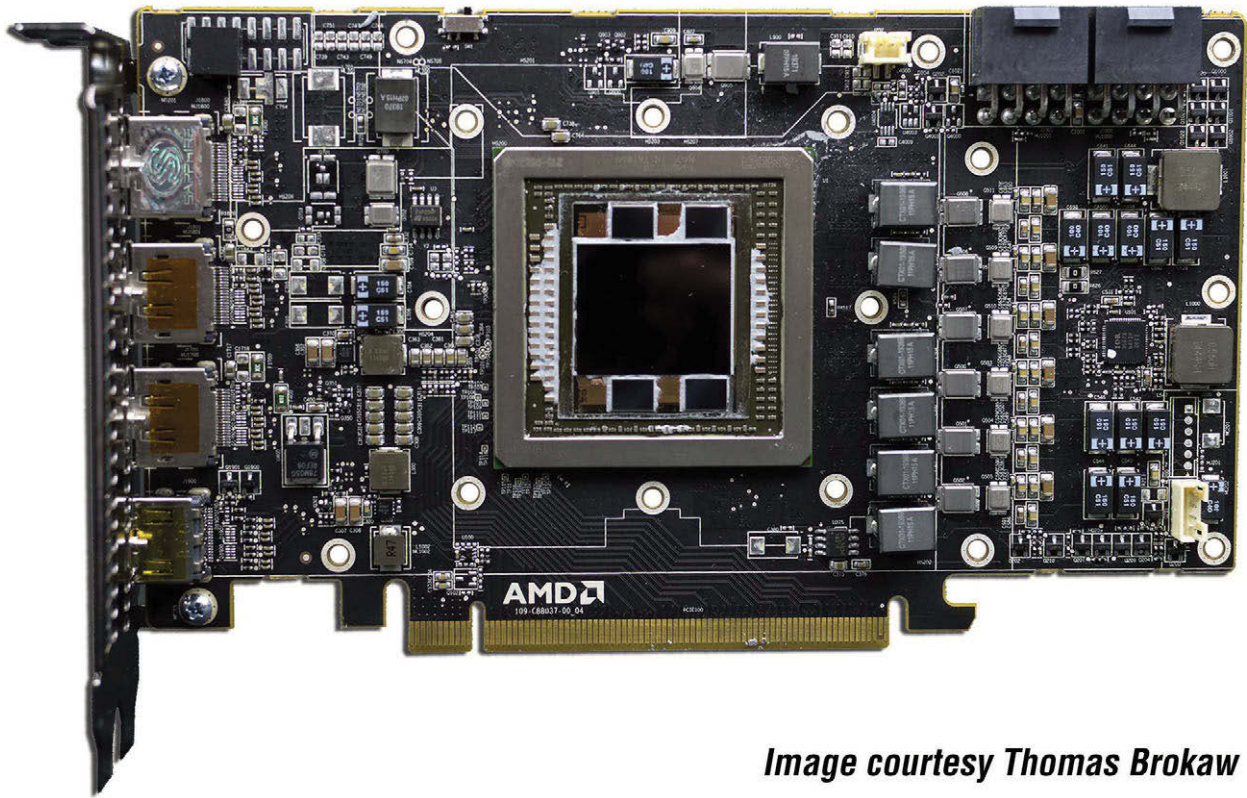


Image courtesy Thomas Brokaw

The SAPHIRE Tri-X R9 Fury OC's PCB is much smaller than its cooler lets on.

is why we ran 3DMark's Fire Strike Ultra test, which renders the test at 3,840 x 2,160. We got a 3729 overall score, and 18.22fps and 14.2fps marks in the two graphics tests, respectively. We ran the card through the Fire Strike Extreme test, which tests at 1440p, and the Tri-X R9 Fury OC scored almost 1,800 points higher than the SAPHIRE NITRO R9 390 we tested last month.

In the games, this card scored consistently about 20 frames per second more than the NITRO, across the board. At 1080p, this card didn't even break a sweat, scoring 118.42fps in Dying Light and 67.35fps in Witcher 3: Wild Hunt. When we jacked the resolution to 1440p, the SAPHIRE Tri-X R9 Fury OC scored better than 80fps in Aliens vs. Predator and Dying Light, better than 60fps in Metro: Last Light, and better than

50fps in Witcher 3: Wild Hunt, with Ultra settings.

As we went to press, we learned that the initial launch of SAPHIRE Tri-X R9 Fury OC cards will be limited, while the standard version will be more readily available. When you go shopping for the R9 Fury, if the SAPHIRE version we tested is sold out, you'll probably be looking at a card with a 1,000MHz core clock. As such, we jumped into the Catalyst Control Center, loaded AMD Overdrive, lowered the core clock to 1,000MHz, and ran the tests again so you can see the performance difference between SAPHIRE's Tri-X R9 Fury OC and a reference card with an MSRP of \$549.

If you're in the market for a graphics card that has a buff enough frame buffer to handle high-resolution gaming with the settings turned all the way up, you'd be mad to pass on the SAPHIRE Tri-X R9 Fury OC. ■



The LEDs near the PCIe power connectors indicate graphics load.

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Everything You Need To Know About Windows 10

Windows 10 is finally here. In an unprecedented move for the company, Microsoft is offering free upgrades for anyone running Windows 7, Windows 8, and Windows 8.1. To make the upgrade process even easier, you could reserve your copy of the new OS months in advance by clicking an icon in your System Tray.

Because the OS has such a dramatic bearing on virtually every aspect of our computing experience, most enthusiasts prefer to take a wait-and-see approach. Making it free and easy to upgrade is a good start, but there's simply too much at stake for most users to jump in with both feet on day one. In this month's "Software Tips & Projects," we'll take a critical look at Windows 10 to show you what you'll get, mention the features that won't make the transition, and give you an idea of how it performs.

The Real Thing

As we went to press, Windows 10 was not available, but we've been tinkering with the Windows 10 Technical Preview for the past six months. We tested with Build 10240, which was the RTM (release to manufacturing) build that would go on to become the final version Microsoft released July 29. Microsoft has gradually moved from adding new features to squashing bugs and improving performance, but we'll take a look at performance numbers a bit later.

What's In The Box?

We've covered the new features you can expect to find packed into the codebase of the new OS, such as virtual desktops that let you press ALT-TAB to switch between multiple simultaneous computing sessions, a new and improved command prompt, support for DirectX



Windows 10 will be available for a variety of computers as well as touch-first devices such as smartphones and tablets.

12 to give game developers better access to the raw horsepower of your system, and deeper Xbox gaming integration. Just like previous iterations of Microsoft's OS, there will be multiple versions of Win10, including Home, Pro, and Enterprise versions, as you might expect, but other versions include Windows 10 Education, Mobile, Mobile Enterprise, and three variations of Windows 10 IoT (Internet of Things).

We suspect that many of those who upgrade to Win10 in the coming months will be taking advantage of the free upgrade offer for current Win7 and Win8/8.1 users. The version you're entitled to, however, depends on the version of the OS you're currently running. Intuitively, if you're running Win7 Starter, Home Basic, or Home Premium, you'll get a key for Win10 Home. Win7 Professional and Ultimate users will get keys for Win10 Pro. Win8.1 users can upgrade to Win10 Home, and

Win8.1 Pro and Win8.1 Pro For Students users get Win10 Pro. Win7/8.1 Enterprise users, as well as WinRT/8.1 RT users are not eligible for the free upgrade.

Win10 Home

We're pleased to see that Microsoft has distilled its consumer-focused OSes to just two. If you're only entitled to the Home version of Win10, what are you missing out on and should you pay to upgrade?

According to Microsoft, Win10 Home features a new streamlined UI meant to work well on PCs, tablets, and 2-in-1s; the voice-recognizing personal assistant Cortana; the sleek new Microsoft Edge (formerly Spartan) web browser; Continuum tablet mode, which replaces the Start menu, Taskbar, and windowed applications with a more Win8.1 experience for touch-first devices; Windows Hello face recognition; support for logging in using your iris and fingerprint; a handful of universal

Windows apps such as Photos, Maps, Mail, Calendar, Music, and Video; and gameplay capture and sharing for Xbox One owners. Another Win10 Home feature that Microsoft isn't exactly advertising loudly is the fact that users will have mandatory Automatic Updates enabled. As we went to press, there was no way for users to disable this feature.

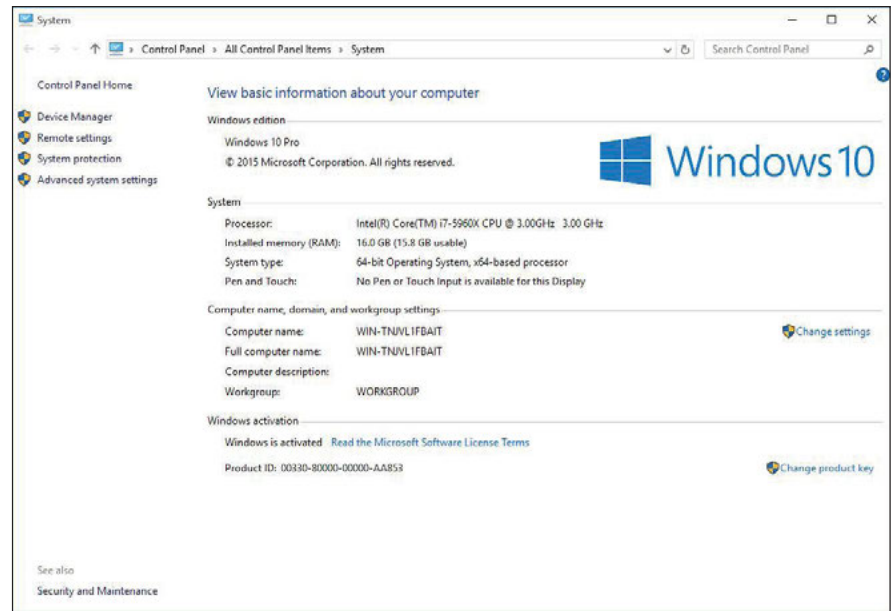
Win10 Pro

Everything included in Win10 Home is also included in Win10 Pro. The extras that Home users will miss out on fall under the category of business experiences. They include domain join capabilities, BitLocker drive encryption, remote access services, a group policy editor, and Windows Update for Business. Enabling Automatic Updates is not mandatory in Win10 Pro. Other extras include the ability to join Azure Active Directory, access to the Win10 Business Store, and enterprise data protection. Microsoft is also making it easier for Win10 Pro users to upgrade to Enterprise edition, and for Win10 Home users to upgrade to the Education version.

Here Today, Gone Tomorrow

Now that you know if your current version of Windows will be free to upgrade, the question remains, what features are being dropped from Win7/8.1? The industry somewhat ominously refers to the loss of certain features as you move from an older to a newer version of the software as deprecation, and Win10 has a number of deprecated features.

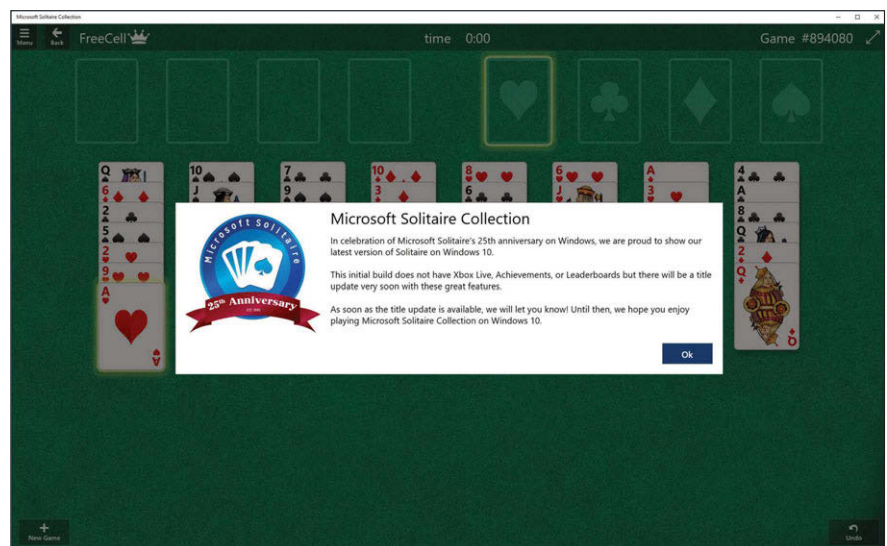
If you enjoyed a previous version of Windows that supported Windows Media Center, prepare to kiss that functionality goodbye. Upgrading to Win10 will unceremoniously remove Windows Media Center, and to date, Microsoft has announced no feature that will stand in for the HTPC-friendly time-shifting, scheduling, and DVR utility. Another ding against Win10 in the eyes of home theater enthusiasts will be the lack of built-in support for DVD playback, though there are plenty of alternatives. Vista and Win7 gadget fans will be



Windows Insiders were able to download the RTM (release to manufacturing) version of Windows 10 early.

disappointed to learn that these handy Desktop-based doodads are getting the axe, resource hogs though they are. Win7 users fond of the preinstalled Solitaire, Minesweeper, and Hearts games will have to go out of their way to suffer their daily drop in productivity; Win10 doesn't come with these games, but you can still download them as universal apps from the Windows Store. Just search for "Microsoft

Solitaire Collection" and "Microsoft Minesweeper." If you're among the handful of people who use a USB floppy drive, you'll need to install the latest driver either from Windows Update or from the manufacturer's website. Windows Live Essentials will mostly make the transition just fine; however, the OneDrive application will be replaced with the inbox version of OneDrive.



Microsoft's Solitaire is no longer preinstalled, but you can find it in the Windows Store.

WINDOWS TIP OF THE MONTH:

How To Get The Get Windows 10 App

Microsoft makes upgrading to Win10 easier than ever with the Get Windows 10 app. But for those of us who don't have the Windows logo in the System Tray, things become slightly more difficult. There are several reasons this might be a problem for you, and each reason has a different fix associated with it.

If your current OS isn't eligible for the free upgrade, your system won't display the icon. The Get Windows 10 app is designed for Win7/8.1 users. If you're running Vista or, heaven forbid, WinXP, then you won't see the icon. Win7 Enterprise, Win8/8.1 Enterprise, and WinRT/RT 8.1 are also excluded from the free upgrade, and the Get Windows 10 app won't show up.

If you have an OS that's eligible for the upgrade but still don't see the icon, it may be because your OS is simply not up to date. Win7 users must have installed SP1 and Win8 users must have the 8.1 update. If either of these is the case, go to Windows Updates via the Control Panel, System And Security, then click Check For Updates and install them. Make sure Automatic Updating is turned on. There are some specific updates you need to have installed. If you're running Win7 SP1, you need KB3035583 and KB2952664. Win8.1 users need KB3035583 and KB2976978. To determine if you have these updates, you'll need to launch and run the Command Prompt as an administrator by typing **command prompt** into the search box in the Start menu or on the Start screen, then right-clicking Command Prompt and clicking Run As Administrator. Type **dism /online /get-packages | findstr 3035583**. Make sure to replace the string of seven digits at the end with the KB number associated with each query. If the update is on your system, you'll see a "Package Identity" response. If it is missing, you'll get no response, just a new prompt ready to input a command. If any come up missing, restoring them is the only way you'll be able to reserve Win10 using the app.

You may be running into problems if you're running a version of Windows that is not genuine. Activate your installation or purchase a valid license key. If your Windows PC, laptop, or tablet is a managed device, such as by a business IT department or as a device managed by an educational institution, you won't be able to access the Get Windows 10 app without your IT administrator's permission. Microsoft also has a few other qualifying criteria that it doesn't get specific about, and for these devices, the Get Windows 10 app won't show up until after July 29th.

If nothing listed above is preventing you from reserving your copy of Win10, there's a way to check your PC's compatibility and enable the icon. Start by opening Notepad and copying the following string of text to it:

```
REG QUERY "HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\AppCompatFlags\UpgradeExperienceIndicators" /v UpgEx | findstr UpgEx
if "%errorlevel%" == "0" GOTO RunGWX
reg add "HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\AppCompatFlags\Appraiser" /v UtcOnetimeSend /t REG_DWORD /d 1 /f
schtasks /run /TN "\Microsoft\Windows\Application Experience\Microsoft Compatibility Appraiser"
:CompatCheckRunning
schtasks /query /TN "\Microsoft\Windows\Application Experience\Microsoft Compatibility Appraiser"
schtasks /query /TN "\Microsoft\Windows\Application Experience\Microsoft Compatibility Appraiser" | findstr Ready
if NOT "%errorlevel%" == "0" ping localhost >nul &goto :CompatCheckRunning
:RunGWX
schtasks /run /TN "\Microsoft\Windows\Setup\gwx\refreshgwxconfig"
```

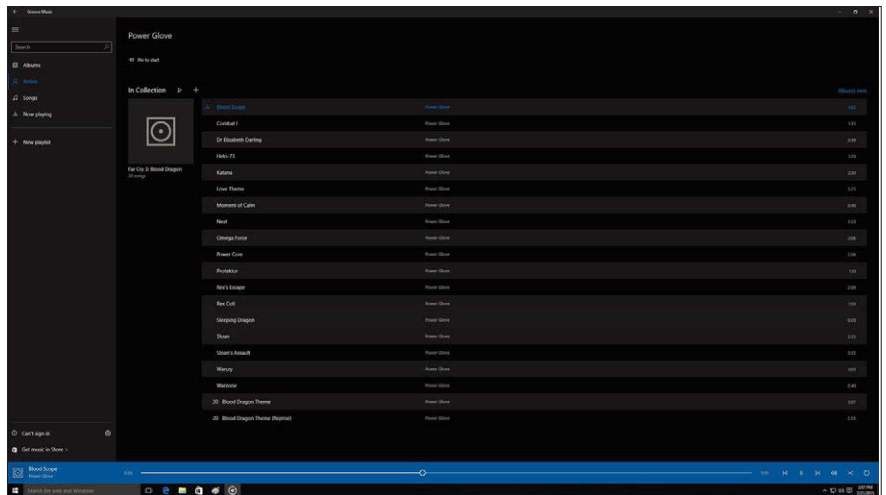
If you're not reading this article on our website, you can go there to access it and copy this wall of text. Click File, Save As, give the file a name such as GetWin10.cmd, then click the Save As Type drop-down menu and click All files (*.*). Choose an easy-to-find location for the file, such as C:\Temp, then click Save. Launch and run the Command Prompt as an administrator again. Type **C:\Temp\GetWin10.cmd** and then press ENTER. The Command Prompt will run the Microsoft Compatibility Appraiser. If you are eligible and have all the prerequisites installed, then the process should be completed in about 20 minutes and the Get Windows 10 app icon should appear in the System Tray.

If you choose to migrate files and settings when you upgrade instead of performing a clean install, you need to be aware of a few things. First, the process uninstalls your antivirus and anti-malware utilities but saves the settings. If your subscription is still valid, Win10's installation process will automatically reinstall the software and reapply your settings. If the subscription is no longer active, the installation will replace it with Windows Defender. If you enjoyed using the OEM applications that shipped with your PC or laptop, you may want to find the install disk for them as Win10 may uninstall them.

According to Microsoft, the Get Windows 10 app—that Windows icon in the System Tray that lets you reserve your copy of Win10—can determine whether third-party applications on your system will be compatible with Win10. The utility will generate a list of the applications it plans to remove because of incompatibility, so save this list before proceeding to look into alternatives or workarounds. By the way, if you happen to be missing the Get Windows 10 app, we have a few troubleshooting tips in a sidebar.

What's The Rush?

When it comes to upgrades, for safety's sake, many enthusiasts tend to



Groove Music is the built-in music-playing utility.

wait for the initial bugs to get fixed. This is usually a good idea, but there are a few reasons you may not want to wait too long.

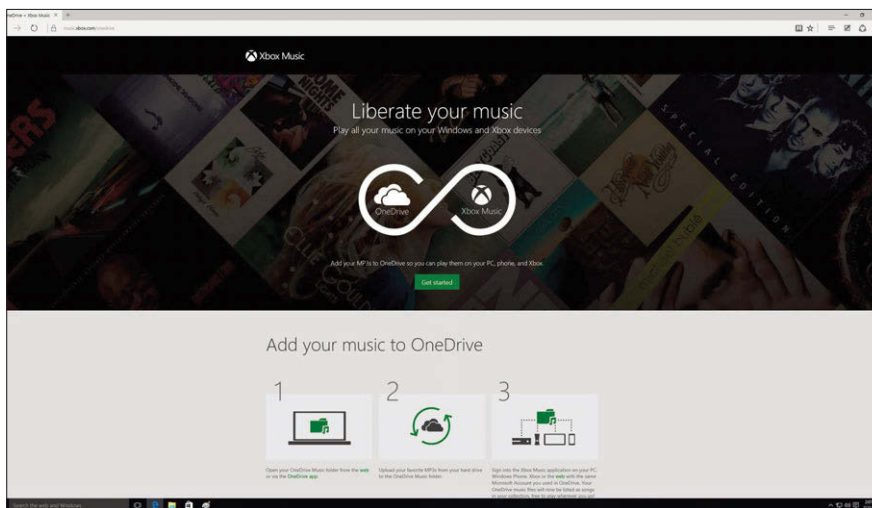
We've already covered the first reason you should pull the trigger in this next 12 months: the OS will cease to be free, becoming a paid upgrade come July 2016.

The second reason has to do with your OS simply getting too old. Microsoft's operating systems all have two different expiration dates: End of Sales and End of Support.

The former refers to when Microsoft stops shipping the particular version of Windows to OEMs and retailers. Often, the retail End of Sales date occurs before the OEM one. According to Microsoft, you should begin thinking about upgrading if your OS has reached its End of Sales date, but as long as your operating system has the latest Service Pack, you'll still get updates and security fixes.

Windows Vista reached its OEM and retail End of Sales dates back in October 2011 and 2010, respectively. Windows 7 Pro reached its retail End of Sales date in October 2013, but its OEM date has not been established, which means that it won't occur for at least another year. Win7 Home Basic, Home Premium, and Ultimate all reached the OEM End of Sales in October 2014. The Windows 8.1 End of Sales dates have not been established for either retail or OEM.

There are actually two End Of Support dates; the first traditionally occurs about five years after the operating system's launch. This period is called the mainstream support phase, and during it you can still request changes in product design and features, download free security updates and hotfixes, and get complimentary and paid support. When the mainstream



The Edge browser is a snappy yet feature-rich browser that comes with Windows 10.

support phase ends, the OS goes into its extended support phase, which eliminates complimentary support and most hotfixes; however, security updates and paid support will continue until this phase ends. If your OS is in the extended support phase, then you should consider upgrading as soon as possible.

For Windows Vista SP2, extended support ends on April 11, 2017. For Windows 7, you have until Jan. 14, 2020, and Windows 8 users have until Jan. 10, 2023. Mainstream support for Win10 is accessible until Oct. 13, 2020, and extended support goes all the way until Oct. 14, 2025, but by then we'll all be driving flying cars and communicating telepathically.

Performance Parity

We tried to anticipate and answer many of the most common questions that crop up surrounding the upgrade to a new OS. But we know the biggest question enthusiasts have about Win10 is, "How does it perform?" Our test system consists of an Intel Core i7-5960X, GIGABYTE X99-Gaming G1 motherboard, PNY GeForce GTX 980 Ti graphics card, 16GB Ballistix Elite DDR4-2400 system memory, and 240GB PNY XLR8 CS2111 SSD for the storage drive.

We installed Win8.1 on it, ran our suite of benchmarks, then installed the RTM version of Win10 (Build 10240) and reran the tests. As you can see, the scores didn't move much between the versions. In the coming weeks and months, we expect the performance difference between Win10 and previous operating systems will become even less noticeable. As DX12 games begin to come out, the real performance benefit of the new OS will become evident.

With Win10's launch imminent, Microsoft has done an excellent job of giving us a handful of compelling reasons to upgrade. Perhaps more importantly, the firm has made it clear that there's little benefit to holding on to Win7 or Win8.1 in the coming year. ■

Benchmark Results	Windows 8.1	Windows 10 Build 10240 (RTM)
3DMark Fire Strike	7627	7540
Graphics Score	7948	7930
Physics Score	16149	16141
Graphics Test 1	42.48	42.65
Graphics Test 2	29.13	28.33
Physics Test	51.27	51.24
Combined Test	16.95	16.89
PCMark 8 Creative Score	4628	4827
SiSoftware Sandra Lite 2015.SP1		
Dhrystone Integer Native AVX2 (GIPS)	284	284.7
Whetstone Single-Float Native AVX (GFLOPS)	181.91	178.85
Multi-Media Integer x32 AVX2 (Mpixels per second)	433.26	429.8
Multi-Media Single-Float x16 FMA (Mpixels per second)	435.89	428
Multi-Media Double-Float x8 FMA (Mpixels per second)	290.35	290.39
Multi-Media Quad-Float x2 FMA (Mpixels per second)	13.48	13.48
Integer Memory Bandwidth B/F AVX2/256 (GBps)	46.67	45.23
Floating Memory Bandwidth B/F FMA/256 (GBps)	48.21	48.68
Cinebench 15 CPU Score	1326	1317
CrystalDiskMark 3.0.1 (MBps)		
Sequential Read	529.4	535.3
Sequential Write	307.9	310.4
4KB Random Q32 T1 Read	292.6	293.3
4KB Random Q32 T1 Write	288.4	287.2
Sequential Read	365.3	381.9
Sequential Write	310.4	309.3
4KB Random Read	26.87	28.29
4KB Random Write	86.32	90.37
POV-Ray 3.7 Beta (pixels per second)	2656.4	2640.96
Unigine Heaven 4.0		
FPS	74.6	74
Score	1878	1880
Games (1,920 x 1,080)		
Metro: Last Light (Very High, 16xAF; SSAA off)	108.33	110.67
Dying Light (High, AO On, AA On, Vsync Off)	149.83	135.2
Alien Vs. Predator (4XAA, 16xAF)	141.2	141.8



TRISTELLAR

To be pioneer



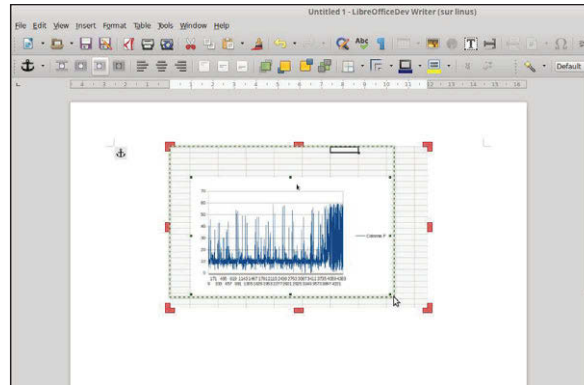
Tristellar disrupts the traditional concept of a PC case, splits components into three cabins; three high ness "V" shape metal frames and full metal shells ensure Tristellar has a reliable and solid structure, the system is not only for an artistic appearance, but also a great cooling performance by separating the most heat-generating parts of a PC. The case supports the latest gaming configuration, it is an excellent choice for gamer or PC builder who want a case with both high performance and aesthetics.

Inside The World Of Betas

THE DOCUMENT FOUNDATION LIBREOFFICE 5.0.0 RC4 BETA

Believe or not, LibreOffice can trace its roots farther back than Microsoft Office. Now under the care and maintenance of The Document Foundation, LibreOffice started its life as fork of OpenOffice.org, which evolved from StarOffice. StarOffice used to be StarWriter, which was originally released way back in 1985 (as in, even before Microsoft Office) by StarDivision. The key takeaway of this brief history lesson in office suite software is that LibreOffice isn't some brand-new suite a couple of coders developed in their spare time as a side project (not that there's anything wrong with that). LibreOffice is a full-fledged, highly polished collection of productivity apps.

LibreOffice's bundle of office software is close enough to Microsoft's well-known offering that even the most superficial comparisons can be instructive. Writer is the obvious analog to Word, and it



can serve as either a WYSIWYG word processor or as a text editor. LibreOffice's Calc serves as an answer to Microsoft Excel, and Impress does the same work as PowerPoint. Draw's closest Microsoft counterpart would be Visio, and Base, if you can't already guess, is most similar to Microsoft Access. LibreOffice also includes Math, a program that lets you

work with mathematical formulas and then insert those formulas in other LibreOffice programs.

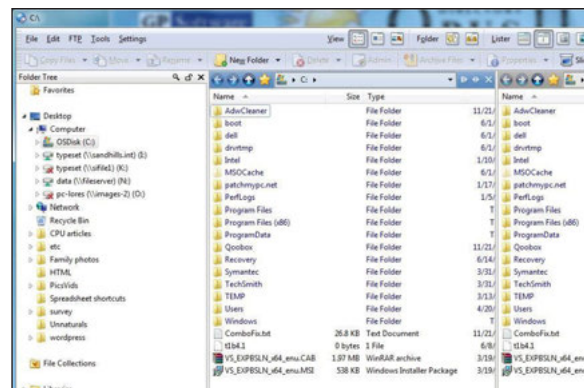
Version 5 of LibreOffice was scheduled to go live a mere days after the time of this writing, so expectedly, the beta is this close to the real thing. It's loaded with new features and functionality, plus it's still as free as it's always been. ■

LibreOffice 5.0.0 RC4 Beta
Publisher and URL: The Document Foundation;
<https://www.libreoffice.org>
ETA: August 2015
Why You Should Care: It's a free office suite that also happens to be a *great* office suite.

GP SOFTWARE DIRECTORY OPUS 11.15.1 BUILD 5688 BETA

Commander-style file managers date back to the days of DOS, so GP Software's Directory Opus is another program that benefits from decades of development. Applications like this are what old guard power users cut their teeth on, and you'll still find plenty of folks who prefer Directory Opus, and/or others like it, to Windows Explorer.

By default, Directory Opus opens to present you with a three-pane layout. The far left pane is a file tree of your entire system, while the other two panes present the contents of any drive/folder/etc. you select. Naturally, firing files and folders across your PC is easier than ever with this format, but anyone who's ever used a Commander-style file manager will tell you this is only scratching the surface. Directory Opus is also a veritable Swiss Army Knife when it comes to working with files. It can convert image files from one format



to another. It can view and edit metadata. Directory Opus is also compatible with popular archive formats such as 7Zip, ZIP, and RAR. In addition to being able to quickly and effectively dive into your PC's files and folders, Directory Opus can also access content on smartphones, tablets, cameras, etc. Toolbars, hotkeys, scripting—you name it, Directory Opus can do it.

The latest beta build makes small changes intended to help Directory Opus be even better at its job. New coding lets Directory Opus display the current file system type in the status bar, and the utility panel now remembers its size when you collapse it, for example. Developer GP Software states that the upcoming update also fixes a handful of pesky problems. ■

Directory Opus 11.15.1 Build 5688 Beta
Publisher and URL: GP Software; <https://www.gpsoft.com.au>
ETA: August 2015
Why You Should Care: Directory Opus gives you total control over your files.

Upgrades That'll Keep You Humming Along

This month, we're calling attention to the "Driver Bay," since both of those updates will prepare your graphics cards for the launch of Windows 10. For our other updates, we have a lot of old favorites here for you, including NoScript, Process Lasso, and Calibre.

SOFTWARE UPDATES

Anfibia Deskman Classic 16.0

If your 9-to-5 involves something in the IT field, maybe you should give Deskman a shot. Deskman, which is deployed globally in schools, businesses, and other organizations, lets an admin take control over how client systems' Windows OS appears, as well as what clients are able to do. Win10 support is the headliner among the list of changes introduced in version 16.0. Deskman's application-blocking feature now works on folders, too. You'll also be able to place restrictions on browser settings, disable Windows Explorer bars and menus, and disable systems' built-in cameras.

<https://anfibia.in>

Bitsum Process Lasso 8.6.1.6

Bitsum's Process Lasso is indispensable for whipping the litany of processes that run in the background into shape. The lightweight application is constantly tweaking process prioritization behind the scenes, with the goal of keeping your system at the top of its game. The latest update is a "minor maintenance release," according to developer Bitsum, introducing a pair of GUI changes and updating several foreign language versions of the program. Process Lasso 8.6, released in mid-July, improves the program's startup time, plugs a small memory leak, refines the error cleanup process, and more.

<https://bitsum.com>

Calibre 2.33

For ebook aficionados, Calibre is a household name. The open-source software does much more than manage your ebook

collection. It can convert ebooks from one format to another, sync with an assortment of ebook readers, and even harvest online news and automatically convert it to ebook format. The most recent version of Calibre adds driver support for the SONY DPT-S1. When you're editing a book, Calibre will now offer suggestions to correct misspelled words, and that can include suggestions from user-generated lists. The update also improves news gathering from MSNBC.com and the *Houston Chronicle*.

calibre-ebook.com

Convertilla 0.5

This handy little app is able to take video and music files and crunch them down into versions that are friendly to your smartphone, tablet, gaming console, etc. Version 0.5 is the first update to Convertilla in a year and half, so it adds quite a few improvements. WEBM, OPUS, AAC, FLAC, APE, and WAV are now supported. Other additions include a progress indicator while Convertilla grinds away on your selected file, a "Keep Aspect Ratio" option, and more output profiles. Several bugs have been stomped, as well.

convertilla.com

InformAction NoScript 2.6.9.32

If you ask the Firefox faithful why they stick with Mozilla's web browser, we'd bet that a number of them would cite this add-on as the reason. NoScript is that good. When you're using Firefox, NoScript checks JavaScript, Java, Flash, and others at the door, keeping you safe even if vulnerabilities crop up in these plugins. This update whitelists certain domains required for Netflix playback,

fixes broken inline script blocking, and makes other minor corrections.

<https://noscript.net>

Nanosystems Supremo 3.0.0.363

Certainly not the first screen-sharing and remote desktop control program, Supremo aims to succeed by being easy to use. The latest version introduces an overhauled UI, and developer Nanosystems claims that version 3.0 offers both increased performance and more stability. Command line support is also included in this new release, along with a lot of small bug fixes.

www.supremocontrol.com

DRIVER BAY

AMD Catalyst Display Driver 15.20.1062.1002

This is the driver you want to get when you make the move to Win10. In addition to support for Microsoft's new OS, the latest driver for AMD's Radeon cards also includes a few extra technologies, such as Virtual Super Resolution, Frame Rate Target Control, and AMD FreeSync.

www.amd.com

NVIDIA GeForce Windows 10 Driver 353.62

Rest assured that NVIDIA isn't going to miss the Win10 party. Released in late July to coincide with the Win10 launch, this driver provides support for the OS to the following GeForce lineups: 900 Series, 700 Series, 600 Series, 500 Series, and 500 Series.

www.nvidia.com

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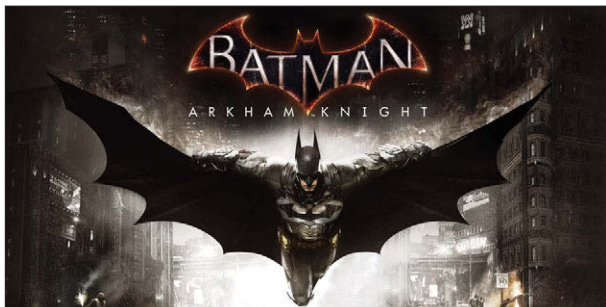
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Yeah, we know you have blogs to post, video to encode, reports to write, and code to compile. We do, too, but you have to take a break once in a while (and maybe blow some stuff up). That's why each month we give you the lowdown on what to expect from the latest interesting PC and console games.



Like many Batman fans, we waited more than 20 years for someone to get a Batman videogame right. Then in 2009, Rocksteady Studios and Warner Bros. Interactive Entertainment dropped the amazing *Batman: Arkham Asylum* on an unsuspecting world. Now, a sequel and a prequel later (the latter of which was not a Rocksteady game wasn't quite up to their standard), Rocksteady and Warner Bros. have launched *Batman: Arkham Knight*, and it's not hyperbole to say that it's the best Batman game ever made.

There's only one problem—the PC version was so broken at launch that Warner Bros. stopped selling it, and in nearly a month since the launch still hasn't managed to fix the game. It's hard to say when the PC port will be viable, but if you're holding out until then, we hope on your behalf that it turns out as good as the console versions. (We couldn't wait, so we played it on Xbox One.)

Arkham Knight is Rocksteady's winning formula perfected: It combines excellent combat and engrossing snippets of detective work in just the right amounts, and sets it all against the backdrop of the series' biggest game world yet. Also, you get to drive the Batmobile, and it was worth the wait.

The game's story seems at first to be pretty standard fare, with Batman facing off against a number of old, familiar foes and one (sort of) new one in a battle for control of Gotham City. But before long, you begin to get glimpses into a second story thread that develops into one of the most interesting Batman tales yet.



Be The Best Batman You Can Be (Just Not On PC)

BY CHRIS TRUMBLE

\$59.99 (XOne, PS4; not currently available for PC) • ESRB: (M)ature
Warner Bros. Interactive Entertainment • www.batmanarkhamknight.com

Combat in the game strikes a comfortable balance between making your character feel immensely powerful and presenting a challenge. There are lots of moves to learn, and although in many little street-side donnybrooks you can just button-mash your way to victory, there are plenty more situations where you need to use the right moves in order to survive. The game gives you lots of opportunities to hone your skills as you acquire them (you “level up” in a similar way to past installments of the series, gaining abilities and gadgets as you go), and you'll thoroughly enjoy the results if you take the time.

As in the previous *Arkham* games, the voice work is great. Kevin Conroy is so good as Batman that they should have dubbed his voice over Christian Bale's in the Nolan trilogy. One new addition to the cast this time around is Jonathan Banks (Mike from “*Breaking Bad*” and “*Better Call Saul*”) as Police Commissioner Gordon. Nobody does cranky like Banks, and the Commish has plenty to be cranky about.

At the end of the day, though, what makes this game truly entertaining is that, simply put, it lets you be Batman. You must stand (mostly) alone against a city full of violent criminals, but through the use of your mind and the vast array of amazing gadgets available to you, you can level the playing field. Driving the Batmobile through the city is a ridiculous amount of fun, and traveling rooftop to rooftop and gliding through the night sky are perhaps even better. Best of all, you don't have to be a tortured billionaire vigilante to don the cowl. ■





ARK: Survival Evolved is a survival game with a prehistoric twist. Like DayZ, Rust, 7 Days To Die, and Minecraft, your initial few hours in ARK will be spent foraging for food and supplies, building a makeshift shelter, and crafting various tools, weapons, and articles of clothing. Other players in this persistent online world can represent a threat, leave you to your own devices, or welcome you into their tribe to help you level up more quickly. But the heart and soul of this game are the dinosaurs.

Early on, your goal is to avoid the aggressive carnivores like the Carnotaurus and the shrill Dilophosaurus at all costs—they will hunt you down and viciously attack without warning. Skittish, docile, and patient dinosaurs, such as the gentle giant Brontosaurus and the winged Pteranodon will generally leave you alone as long as you don't provoke them. As you're able to craft more deadly weapons and stronger armor, you'll shift from hunted to hunter. The crafting system is fairly deep, but like many of these types of games, not everything is intuitive. You'll get the best results with a wiki handy.

One of the most popular high-level activities in ARK is the domestication of many of the dinos you encounter. Although the process is rather involved and varies between species, once accomplished, you can mount them, and use them as transportation or as allies in battle against even more powerful creatures and whole tribes. You can also use your tamed beasts to defend your base, act as watch dogs, or simply as pets that accompany you on your travels.

Farming is another way to eliminate the constant search for food from your daily routine, just remember to gather as much feces as possible



We're Going To Need A Bigger Hut

BY ANDREW LEIBMAN

\$29.99 (Steam Early Access; PC/Linux/OS X/XOne/PS4 in June 2016)
ESRB: (R)ating Pending • Studio Wildcard • www.playark.com

(including your own). You can grow berries for food and taming, as well as fruits and vegetables, opening up more complex recipes such as soups, medicine, and buffs.

If all this weren't enough, ARK also pits you against a rather unforgiving environment, filled with lush sprawling jungles, sun-scorched beaches, hidden inland caves, and shimmering lakes and rivers populated with man-eating creatures. There are also hints of underwater caves and dead volcanoes to explore. Your character, playable in either first or third-person, can suffer from excessive heat, cold, hunger, thirst, exhaustion, and a handful of other ill effects. As you earn levels, you'll unlock engram points that can be spent on recipes for tools, clothes, weapons, armor, saddles, and building materials.

When you die, and early on we died often, you can respawn in a random location in the region you were in or simply start a new character. By choosing to respawn in a random location, we could make our way back to our original camp and loot our body to recover dropped items. More often than not, however, we never found our body. Thankfully, you retain your unlocked engrams, which makes rebuilding your basic tools of survival a fairly short if tedious process.

ARK: Survival Evolved is a Steam Early Access game, with a final release set for June 2016. Despite the long lead time, the game is surprisingly fleshed out. We're more fans of single-player experiences, and ARK has an accommodating mode that lets you uncover the mysteries of ARK at your own pace. There's lots to love for PvP fans as well, including forming tribes and defeating raid-like bosses. ARK is definitely worth keeping an eye on in the coming months.



MASSIVE CHALICE

Your first Kickstarter campaign raises more money than any other crowd-funded videogame. That's the story of Double Fine Productions' *Adventure*, which raised \$3.3 million on its way to becoming the most successful Kickstarter videogame campaign at the time. (Between then and now, other crowdfunded games have gone on to raise more capital.) Double Fine's second Kickstarter campaign, *Massive Chalice*, raised *only* \$1.2 million, but that still adds up to a whole lot of people excited to see the developer's take on turn-based strategy.

Briefly, *Massive Chalice* begins by introducing you, Immortal Ruler of the Nation, who must hold a kingdom together over the course of a 300-year war with the Cadence, the game's opposing force. The Cadence keeps encroaching on your turf, but if you can keep them at bay long enough, the eponymous Chalice—and it is massive indeed—becomes powerful enough to come to your aid.

Boiled down to its core, *Massive Chalice* is both a dynastic strategy game and a turn-based tactical game. The latter might tempt you to call *Massive Chalice* “XCOM with bows,” and it's not an entirely unfair assessment. In combat, you'll guide your party of heroes against the Cadence's beasts, wrecking fools and gaining XP in the process. There's also a roguelike element to combat, since heroes who die are dead-dead, but *Massive Chalice*'s tactical side should be familiar to anyone who's experienced with the game's ancestors.

As you'll soon find out, *Massive Chalice*'s obsession with ancestry goes way beyond being an homage to its forerunners. The core component of the game is its Bloodlines mechanic, which lets you breed, literally, the next generation of heroes. Although you, the ruler, live out the entire 300 years (because

A New Breed Of Turn-Based Strategy

BY VINCE COGLEY

\$19.99 (PC, XOne) • ESRB: (T)een • Double Fine Productions
www.massivechalice.com

magic), your heroes are decidedly mortal. It's by design that their children pick up their swords and continue the fight. Because your heroes pass on their traits, both positive and negative, it's vital that their offspring don't wind up at the shallow end of the gene pool. Winning at *Massive Chalice* requires you to be both a savvy field commander and a shrewd matchmaker.

Marrying Hero A to Heroine B also creates additional classes. *Massive Chalice* starts with just three classes—Caberjack (melee), Hunter (ranged), and Alchemist (AoE)—pairing different heroes produces new hybrid classes. Putting a Caberjack together with a Hunter can produce a Shadowjack, for example.

Aside from inherited traits, heroes also develop personalities. These too can be advantageous, such as Stalwart, or debilitating, such as Nihilistic. You can influence a hero's personality, but only to an extent. The RNG can be a cruel mistress, handing you a Nervous and Nearsighted, yet Bountiful (read: fertile) hunter. At higher difficulty settings, drawing a bad hand from the lineal deck can be the game's most difficult challenge to overcome.

The sense of realism is almost palpable. It helps your heroes to feel more like real people and less like an army of medieval redshirts. At the same time, when *Massive Chalice* hits one of your families with a genetic whammy, it feels less like an escape from reality and more like a taunting reminder that your kid's cowlick is your fault.

Still, we really enjoyed *Massive Chalice*'s tactical combat, and the combination of just enough depth and higher difficulty settings helps the game stay fresh even after several playthroughs. However much *Massive Chalice* succeeds at these elements, though, your enjoyment will come down to whether you think the Bloodlines feature is pure eugenic bliss or a crooked pinky finger too far. ■



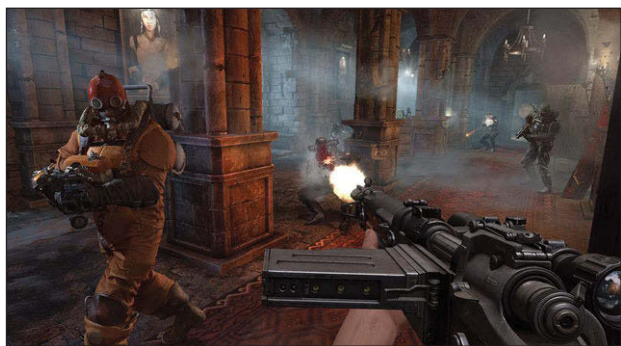


The 2014 game *Wolfenstein: The New Order* certainly wasn't the first videogame to send players back into the world of B.J. Blazkowicz and his never-ending struggle to rid the world of Nazi oppression, but it was easily the best. In the game, Blazkowicz falls into a coma after being injured in combat and wakes many years later in the 1960s to find that Hitler's Nazi empire won World War II. The alternate-universe setting allowed the developers to pit players against (and, at times, give them access to) all manner of fantastic mechanized terrors that in total represent one idea of what the world might have looked like.

The game looked great, had tight controls and a number of inventive set piece levels, and even subjected Blazkowicz to a moral quandary or two, which the developers cleverly used to surprise us: Blazkowicz wasn't just a muscle-headed killing machine after all. He was a guy with a job to do, for sure, but one who also had dreams of a better life and even a compassionate side. In any event, the game was a blast, so when we found out that MachineGames and publisher Bethesda Softworks were working up a standalone expansion of the game, we reported for duty.

Wolfenstein: The Old Blood is a prequel to *The New Order*, which means that the tech you see Nazi soldiers toting around is a bit scaled back comparatively, but MachineGames still managed to populate Castle Wolfenstein with some pretty impressive mechanical monstrosities.

The story picks up with B.J. heading toward the castle to seek out the clandestine location of the evil General "Deathshead" Strasse



It's Good To Be Blazkowicz

BY CHRIS TRUMBLE

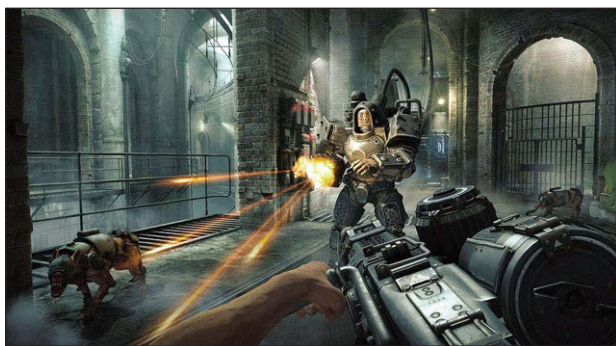
\$19.99 (PC, XOne, PS4) • ESRB: (M)ature • Bethesda Softworks
www.wolfenstein.com

in an attempt to stem the tide of technology the man is developing for the Reich. In order to get this intel, B.J. must take it from the commandant of Wolfenstein, a Nazi archaeologist named Helga Von Schabbs. For her part, Von Schabbs is currently and obsessively trying to dig up artifacts of the occult that may have been left behind by King Otto I, who we learn in the game was the builder of Castle Wolfenstein.

Because you are B.J. Blazkowicz, you are captured almost immediately and forced to free yourself and scrounge for weapons in an effort to salvage your mission. Along the way, you'll have access to numerous weapons and asked to undertake all manner of chores, and (naturally) you'll leave a trail of Nazi dead in your wake.

The *Old Blood*'s gameplay elements and control scheme are largely unchanged with the exception of a few minor techniques here and there, although the precise nature of the game's combat (or, at least, the nature of B.J.'s foes) shifts fairly dramatically. The *Old Blood* tips its hand early if you are industrious enough to read many of the notes you find lying around in the game; something dark and hungry does in fact rest beneath the earth in the region, and B.J. finds himself fighting this evil scourge before *The Old Blood* is over. Also, there are zombies.

The game is fairly short, but the good news is that it is also quite a bit of fun and costs just under 20 bucks. Although it doesn't break much new ground, *Wolfenstein: The Old Blood* provides several hours of fun, cathartic action and more of the wit and wisdom of one B.J. Blazkowicz.



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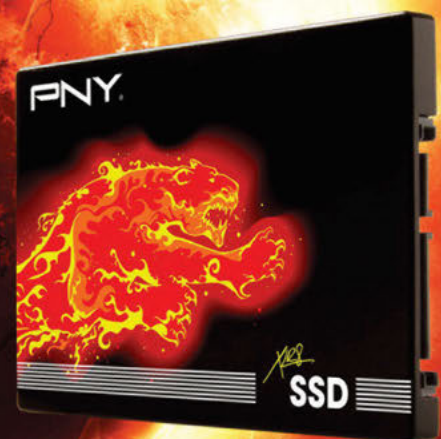
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Q&A With Richard Surroz & Lee Harrington

Modding Veterans Discuss Cooler Master's New MasterCase 5

What do Richard Surroz and Lee Harrington have in common? For starters, they are both accomplished case modders and PC builders. They are makers, and they embody the spirit of tinkering that is growing in popularity by leaps and bounds. Additionally, they have both spent time with Cooler Master's new MasterCase 5. MasterCase 5 is a new modular case system that grew out of Cooler Master's MasterConcept project, in which industry experts and modders from all corners of the globe came together in Taiwan to bring something brand-new to the PC case market.

We recently got a chance to discuss the case with them and find out what they think.



MasterCase 5

Q: Hi guys, and thanks for taking time out of your busy schedules to talk with us. You've each had a chance to spend some hands-on time with the MasterCase 5, correct? Can you share some of your initial impressions of the case?

LH: When I first saw the MasterCase 5, it reminded me of a battlestation

or fortress. The sleek and clean look is the perfect canvas for anyone to "Make It Yours!"

RS: Cooler Master really included some of the free-form modularity concepts into their first case released from the MasterConcept project. I think the flexibility this will provide to builders from novice to advanced will revolutionize their

offerings. The case is refined, spacious, and offers a great value for the price.

Q: What did you think the first time someone described MasterCase 5 to you, and did the case live up to its billing and/or did it surprise you in any way?

RS: I was part of a team of modders Cooler Master brought to Taiwan

to participate in the workshops to help design the new cases. The prototypes we worked on had extremely rough features, which were improved and refined in the final product. I was pleasantly surprised to see that Cooler Master listened to our feedback, and it shows in the retail product.

LH: My first thoughts were skeptical because I didn't want to get too excited. MasterCase 5 far exceeded what was described to me.

Q: What about MasterCase 5 do you think is its best feature for DIY system builders, and why?

RS: The best feature is not one specific feature, it's the hyper-modularity—not only in this case, but in others you will see in the near future. It will be a new paradigm in case design.

LH: Agreed, the best feature of the MC5 is its modularity. Being able to change it the way you want is awesome. For a user to be able to start where they want and add the options they want, when they want, is perfect.

Q: You're both experienced case modders; what does the MasterCase 5 mean for case modding? Does it make getting the results you want easier, and if so, how?

LH: Every artist has their own style. This case is the perfect blank canvas for any modder to work from. The best part



MasterCase Pro 5



is that some of the work is already done for us modders, like having more screws to take case components out instead of rivets. Also, having the option to install watercooling without much hassle or cutting.

RS: The modularity and flexibility means we can focus on modding other parts of the case for aesthetics vs. function. It also means we can get more miles out of the new cases as their external aesthetic features are also modular.

Q: What else can you tell us about the MasterCase 5 in particular, or Cooler Master's MasterConcept in general?

RS: The MasterConcept program really is unique. Cooler Master is exploding out of the box. Involving a global group of case modders not only brings in fresh ideas, but it also allows them to verify and validate their strategy, tactics, and product designs before the designs hit the critical eye of the public—especially enthusiasts, who can be very hard on companies (especially on social media).

LH: MasterConcept is a great idea; it shows that Cooler Master is trying to reconnect with the users and is listening to them, as well. The MasterCase 5, and being able to make something yours, is the perfect thing for the DIY era. ■

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